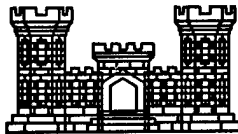


Water Conservation Study (Water and Energy)  
Energy Engineering Analysis Program (EEAP) FY94S  
Fort Knox, Kentucky

*Final Report*

*Volume 3 of 3*

CONTRACT #DACA01-94-D-0034  
SYSTEMS CORP PROJECT #94013.03  
DECEMBER 30, 1994



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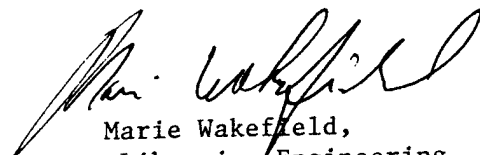


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## 7 FEMP PROJECT 1

FY94S WATER CONSERVATION STUDY (WATER AND ENERGY), FT. KNOX, KY

### FEMP PROJECT No. 1 - REPLACE STEAM TRAPS IN POST LAUNDRY

The project consists of the replacement of all of the steam traps in Building 18, the Post Laundry. The existing bucket and float and thermostatic steam traps have failed. The failed steam traps are allowing live, high pressure steam to pass in an uncontrolled manner through the steam traps into the condensate system where it is vented to the atmosphere. The failed steam traps are causing an annual energy loss of 6,548 Mwh per year and 1.8 million gallons of water per year. Annual savings are \$68,816.

The project includes removal of existing steam traps, installation of new steam traps, stainless steel identification tags for the new steam traps, steam trap database, steam trap testing equipment, and operating and maintenance manuals and training. The construction cost is estimated to be \$29,278.

Below is a detailed index of the information included in this section:

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LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FEMP-1  
LCCID FY95 (92)

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: FEMP-1      STEAM TRAPS AT POST LAUNDRY

FISCAL YEAR 1995      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 12-27-94      ECONOMIC LIFE 20 YEARS      PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	29878.
B. SIOH	\$	1494.
C. DESIGN COST	\$	1494.
D. TOTAL COST (1A+1B+1C)	\$	32866.
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.
F. PUBLIC UTILITY COMPANY REBATE	\$	0.
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$	32866.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST \$/ MWH (1)	SAVINGS MWH/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ 46.40	0.	\$ 0.	15.08	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 10.51	6548.	\$ 68819.	18.58	\$ 1278666.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.88	\$ 0.
N. TOTAL		6548.	\$ 68819.		\$ 1278666.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.88	\$ 2235.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 33257.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 33257.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 71054.

5. SIMPLE PAYBACK PERIOD (1G/4) .46 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1311923.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 39.92  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 23.85 %



# Spirax/sarco

## Cast Iron Inverted Bucket Steam Traps B Series

The trap contains an inverted bucket mechanism which responds to the difference in density between steam and condensate. The discharge action is cyclic. Condensate and non-condensibles are discharged close to steam temperature.

Model ⇨	B1H	B2	B3	B4	B5
PMO	250 psig (see below)				
Sizes	1/2", 3/4"	3/4"	1"	1-1/4"	2"
Connections	NPT				
Construction	Cast Iron Body, Stainless Steel Mechanism				
	S.S. Bucket	Brass Bucket			
Options	Bimetal air vent (add "2" to model No. eg. B12H, B22, etc.)				
	Integral strainer (add "S" to model No. eg. B1HS, B2S, etc.)				
		Stainless Steel Bucket			

### CONSTRUCTION MATERIALS

No.	Part	Material
1	Cover	Cast Iron ASTM A126 CL B
2	Cover Screws	Steel ASTM A 449
3	Body	Cast Iron ASTM A126 CL B
4	Bucket B1H, B12H	Stainless Steel AISI 301/302/304
	B2 - B5, B22 - B52	Brass ASTM B 36
5	Valve Guide Plate (Seat Bracket)	AISI 301/302/304
6	Cover Gasket	Graphite
7	Valve Seat	Stainless Steel hardened AISI 420 F
8	Valve Head (Ball)	Stainless Steel hardened AISI 440
9	Valve Lever (Bucket Arm)	Stainless Steel AISI 301/302/304
10	Air Vent (optional)	Series 300 SS and 400 SS
11	Strainer Screen (optional)	
	B1H	Monel, #16 mesh
	B2 to B5	Brass, 1/16" perforations
12	Cap B1H, B2, B3	Brass ASTM B16
	B4, B5	Steel ASTM A 105 Gr 11

### TYPICAL APPLICATIONS

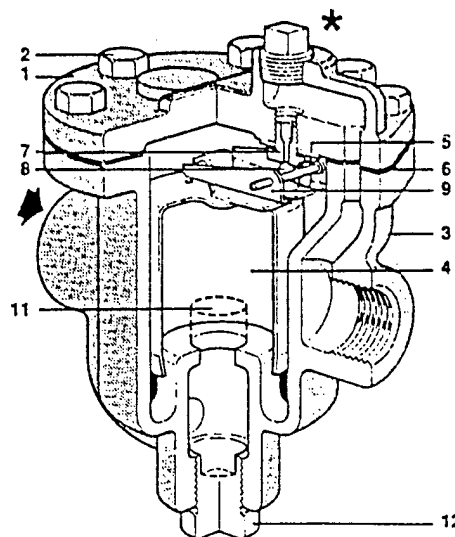
Steam main drip stations, laundry equipment, industrial dryers and storage tanks.

### OPTIONAL EXTRAS

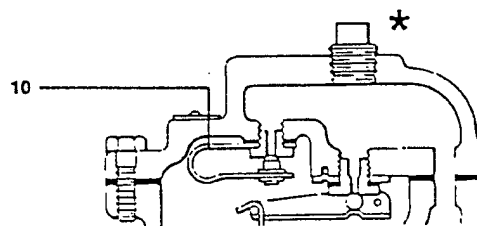
Stainless steel strainer screens are available for all types.

Stainless steel buckets are available for types B2 to B5.

The optional Bimetal Air Vent allows rapid air removal on cold start-up. The vent closes at approximately 200°F. and will remain closed during normal operation of the trap.



CAPACITIES — SEE TIS 2.408



\* Top plug not provided on B1H, B12H, B2, B22, B5, B52

### LIMITING OPERATING CONDITIONS

Max. Operating Pressure (PMO)	15 psig (1 barg)	125 psig (9 barg)
(Determined by Orifice selected. See Capacity and Selection Data on TIS 2.408)	30 psig (2 barg)	180 psig (12 barg)
	75 psig (5 barg)	250 psig (17 barg)

Max. Operating Temperature 450°F (232 °C) at all operating pressures

\* For superheated steam applications, a check valve should be installed at the trap inlet.

### PRESSURE SHELL DESIGN CONDITIONS

PMA	250 psig/0-450°F	17 barg/0-232 °C
Max. allowable pressure		
TMA	450°F/0-250 psig	232 °C/0-17 barg
Max. allowable temperature		

```

=====
Estimate:      BASE LAUNDRY      Date:      22-Dec-94
Description:   REPLACE STEAM TRAPS
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY      Job #:      94013.03
Sq. footage:  BLDG 18           City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0100340100	CREATE COMPUTER DATABASE					1.00 LS	
Unit values		0.00	0.00	0.00	0.00	1000.00	1000.00
Totals		0.00	\$0	\$0	\$0	\$1,000	\$1,000
0100340120	CONDUCT MAINTENANCE TRAINING					1.00 LS	
Unit values		0.00	0.00	0.00	0.00	2000.00	2000.00
Totals		0.00	\$0	\$0	\$0	\$2,000	\$2,000
0181602730	PROVIDE STEAM TRAP TESTING EQUIPMENT					1.00 LS	
Unit values		0.00	0.00	0.00	0.00	5000.00	5000.00
Totals		0.00	\$0	\$0	\$0	\$5,000	\$5,000
U01 GENL RQMTS		0	\$0	\$0	\$0	\$8,000	\$8,000

```
=====
Line #      Description
-----
              Manhours  Matl    Labor  Equipment  Sub      Total
=====

0208106400  STAINLESS STEEL I.D. TAGS
Unit values      0.00      0.00      0.00      0.00      74.00 Ea.  5.00
Totals           0.00      $0        $0        $0        $370      $370

U02 SITEWORK      0        $0        $0        $0        $370      $370
```

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1562721010	REMOVE EXISTING HVAC STM TRAP F&T 15PSIG 3/4"IPS					
					53.00 Ea.	
Unit values	2.00	0.00	30.25	0.00	0.00	30.25
Totals	106.00	\$0	\$1,603	\$0	\$0	\$1,603
1562721010	SUPPLY AND INSTALL NEW HVAC STM TRAP F&T 15PSIG 3/4"IPS					
					53.00 Ea.	
Unit values	1.00	79.00	15.13	0.00	0.00	94.13
Totals	53.00	\$4,187	\$802	\$0	\$0	\$4,989
1562721020	REMOVE EXISTING HVAC STEAM TRAP F&T 15PSIG 1"IPS					
					21.00 Ea.	
Unit values	2.00	0.00	30.25	0.00	0.00	30.25
Totals	42.00	\$0	\$635	\$0	\$0	\$635
1562721020	SUPPLY AND INSTALL NEW HVAC STEAM TRAP F&T 15PSIG 1"IPS					
					21.00 Ea.	
Unit values	1.00	120.00	15.13	0.00	0.00	135.13
Totals	21.00	\$2,520	\$318	\$0	\$0	\$2,838
U15 MECHANICAL	222	\$6,707	\$3,358	\$0	\$0	\$10,065

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	222	\$6,707	\$3,358	\$0	\$8,370	\$18,435
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	22.00%		\$739			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	5.00%				\$419	
TOTAL BEFORE CONTINGENC		\$6,707	\$4,097	\$0	\$8,789	\$19,592
CONTINGENCY	40.00%					\$7,837
BOND	2.50%					\$490
PROFIT	10.00%					\$1,959
JOB TOTAL						\$29,878

```

=====
Estimate:      BASE LAUNDRY      Date:      22-Dec-94
Description:   REPLACE STEAM TRAPS
Project:       LIMITED EEAP (WTR) Bid Date:
Location:      FORT KNOX, KY      Job #:      94013.03
Sq. footage:   BLDG 18           City indx: Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U01 GENL RQMTS      0      $0      $0      $0      $8,000      $8,000
U02 SITEWORK        0      $0      $0      $0      $370      $370
U15 MECHANICAL     222     $6,707     $3,358     $0      $0      $10,065
TOTAL              222     $6,707     $3,358     $0      $8,370      $18,435

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        22.00%      $739
EQUIPT MARKUP        0.00%      $0
SUB MARKUP           5.00%      $419

TOTAL BEFORE CONTINGENC  $6,707     $4,097     $0      $8,789      $19,592
CONTINGENCY          40.00%      $7,837
BOND                  2.50%      $490
PROFIT                10.00%      $1,959

JOB TOTAL                                           $29,878

```

FY94S EEP 5 FT. KNOX WATER CONSERVATION STUDY  
 CALCULATION WORK SHEET  
 FACILITY NO.:

Bldg 18, Post Laundry  
 DATE 31 October 1994

ECO Number 8 Steam Trap Replacement

Baseline

Quantity	Trap Size	PPH Steam Loss/Trap	Annual Steam Loss	Annual Water Loss
11	1 inch F&T	49	4,721,640 pounds	566,144 gallons
28	3/4 inch F&T	42	10,301,760 pounds	1,235,223 gallons
Annual Steam Consumption			15,023,400 pounds/yr 1,190 btu/lb	1,801,367 gallons/yr or
			17,877,846,000 btu/yr	7,926,014 liters/yr
Energy Loss at a Boiler Efficiency of 80% =			22,347,307,500 btu/yr or	
			6,548 mwh	
			6,548 mwh \$10.51 per mwh	1,801,367 gallons/yr \$0.9409 per kgal
			\$68,816 per year	\$1,695 per year

Proposed Retrofit

Replace all steam traps in Building 18, laundry facility.

Savings Summary

Annual Energy Savings of	6,548 mwh
Annual Energy Cost Savings of	\$68,816
Annual Water Savings of	7,926,014 liters
Annual Water Cost Savings of	\$1,695
Annual Chemical Savings of	\$540

## 8 FEMP PROJECT 2

FY94S WATER CONSERVATION STUDY (WATER AND ENERGY), FT. KNOX, KY

### FEMP PROJECT No. 2 - HEATING DISTRIBUTION SYSTEM MANHOLE REPAIRS

The projects consists of the repairs to the heating distribution system manholes for the underground distribution systems serving the following boiler plants: Buildings 852, 1537, 1725, 1731, 1785, 1797, 2780, 5213, 5943, 6615 and 7203. The project will reduce heating distribution system heat loss by 6935 Mwh per year, yielding energy cost savings of \$72,887 per year. The repairs consist of the dewatering of the manholes, replacement of failed sump pumps, removal of all pipe insulation, installation of new closed cell pipe insulation and aluminum jacketing, regrouting of manholes, and installation of new pipe-wall penetration seals. The construction cost is estimated to be \$282,541.

Below is a detailed index of the information included in this section:

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Catalog Cut Sheet . . . . .	8-3
Project Cost Estimate . . . . .	8-4
Project Calculation Sheets . . . . .	8-10



LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FEMP-2

LCCID FY95 (92)

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: FEMP-2      SUMP PUMP REPLACEMENT

FISCAL YEAR 1995      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 12-27-94      ECONOMIC LIFE 20 YEARS      PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	224714.	
B. SIOH	\$	11236.	
C. DESIGN COST	\$	11236.	
D. TOTAL COST (1A+1B+1C)	\$	247186.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		247186.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST \$/ MWH (1)	SAVINGS MWH/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ 46.40	0.	\$ 0.	15.08	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 10.51	6935.	\$ 72887.	18.58	\$ 1354238.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.88	\$ 0.
N. TOTAL		6935.	\$ 72887.		\$ 1354238.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.88	\$	0.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTOR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 0.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 72887.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.39 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1354238.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 5.48  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.14 %

### Definition

This special high temperature Series 1400 submersible sump pump is a heavy duty unit, suitable for continuous operation in 200°F water. Designed with heat resisting components throughout to operate as successfully in a maximum 200°F ambient as it does in 40°F ambient applications. Suitable for a Ph range of 6.0 to 9.0. The pump is furnished with a suction strainer and a 1½" I.P.S. discharge connection.

### Applications

- Boiler Blow Down
- Condensate Return
- Steam Tunnels
- Car Wash
- Laundry Rooms

### Standard Construction

**PUMP, END BELL & MOTOR SHELL**—Cast Iron.

**MOTOR**—½ HP, 1750 RPM, Single Phase, 60 Hz., 115V. or 208/230V. with Class 'F' insulation. Motors are hermetically sealed using high temperature capacitor and relay starting components with built-in overload protection. THREE PHASE is not available.

**IMPELLER**—Weillite phenolic (Bronze, Cast Iron and 316 Stainless Steel are available as options).

**SHAFT**—Common pump/motor shaft is of 303 stainless steel.

**BEARINGS**—Factory sealed, high temperature grease lubrication ball type.

**MECHANICAL SEAL**—Heat resisting of stainless steel and carbon components.

**STRAINER**—Perforated steel plated.

**POWER CABLE**—10 ft. length of high temperature PVC cable suitable for 200°F with three prong grounding plug.

**CONTROL ARRANGEMENT**—Available in a closed circuit design (Fig. 14-AHT) and a mercury differential float switch arrangement (Fig. 14-BHT & 14-CHT). The differential mercury float switch can be bracket mounted on the pump or provided loose for mounting on the discharge pipe. Designed with a float ball and PVC jacketed cable suitable for 200°F, this switch is available in either 115V. or 208/230V., single phase. Cables are available in 10 ft. lengths and complete with a "piggy back" combination grounded plug and receptacle.

### Model Identification

1½-140X24½/3

- |                                                              |    |                       |    |                 |   |                     |   |            |   |                          |   |             |     |
|--------------------------------------------------------------|----|-----------------------|----|-----------------|---|---------------------|---|------------|---|--------------------------|---|-------------|-----|
| Discharge size                                               | 1½ | Major catalog section | 14 | Model variation | 0 | Control designation | X | Horsepower | 2 | Speed in number of poles | 4 | Design Code | ½/3 |
| <p>3—Closed Circuit<br/>4—Mercury Float Switch—Piggyback</p> |    |                       |    |                 |   |                     |   |            |   |                          |   |             |     |

FIG. 14-AHT

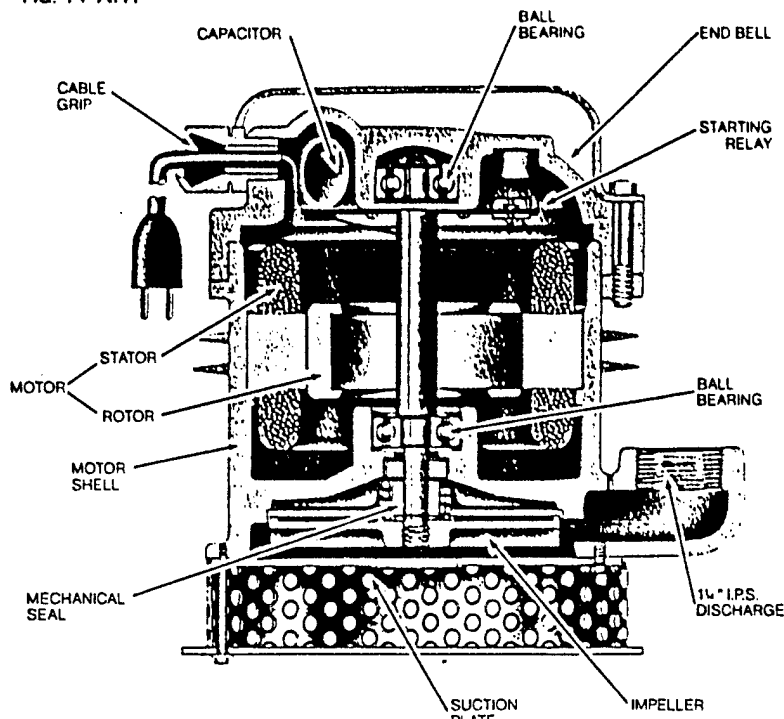


FIG. 14-BHT

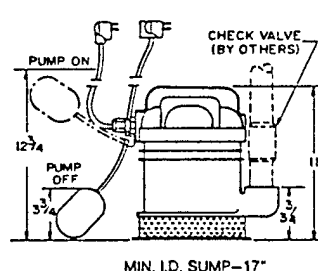


FIG. 14-CHT

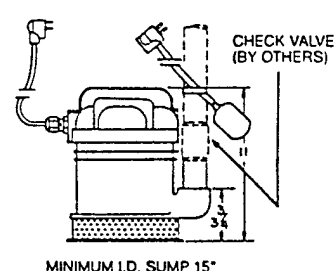
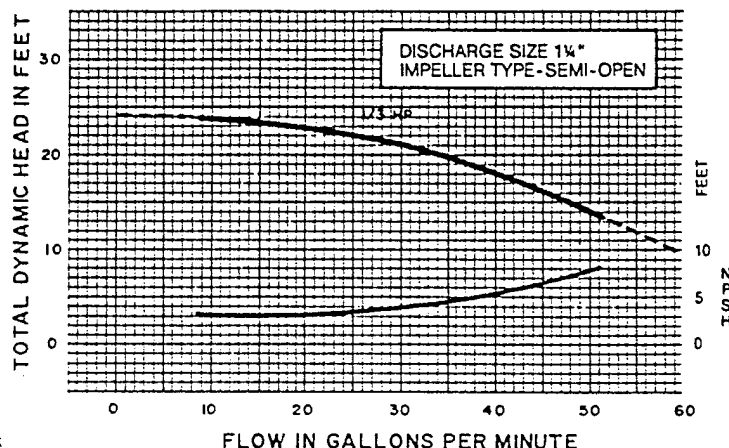


FIG. 14-DHT



```

=====
Estimate:      STEAM DIST. SYS      Date:      11-Nov-94
Description:   REPLACE SUMP PUMPS IN MANHOLES
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY        Job #:      94013.03
Sq. footage:  POSTWIDE             City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0214040600	DEWATER, PUMP "DIAPH 8HR, ATTEND 2HR/D, 20' SUCTION&100' DISCHRG HOSE					53.00 Ea.	
Unit values		8.00	0.00	185.04	8.02	0.00	193.06
Totals		424.00	\$0	\$9,807	\$425	\$0	\$10,232
U02 SITEWORK		424	\$0	\$9,807	\$425	\$0	\$10,232

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====

0410160700   GROUTNG MANHOLE WALLS
Unit values      4.00      14.98      73.53      0.11      53.00 Ea.
Totals          212.00      $794      $3,897      $6          0.00      88.62
              212.00      $794      $3,897      $6          $0      $4,697

U04 MASONRY      212      $794      $3,897      $6          $0      $4,697
```

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1524600400	REMOVE EXISTING SUMP PUMP, STEAM DIST MANHOLES					
					53.00 Ea.	
Unit values	16.00	79.50	364.50	0.00	0.00	444.00
Totals	848.00	\$4,214	\$19,318	\$0	\$0	\$23,532
1524600800	SUPPLY AND INSTALL NEW SUMP PUMP, CI BASE 21GPM					
	15' HD, 1/3 HP IN STEAM DIST MANHOLE				53.00 Ea.	
Unit values	16.00	102.00	364.50	0.00	0.00	466.50
Totals	848.00	\$5,406	\$19,318	\$0	\$0	\$24,724
1556512920	VALVE INSULATION JKT, 6", GATE					
					159.00 Ea.	
Unit values	1.00	27.00	22.83	0.00	0.00	49.83
Totals	159.00	\$4,293	\$3,630	\$0	\$0	\$7,923
1556517440	PIPE COVER FBGL ASJ 2"WL 6" IPS					
					5300.00 L.F.	
Unit values	0.16	3.45	3.10	0.00	0.00	6.55
Totals	848.00	\$18,285	\$16,429	\$0	\$0	\$34,714
1556517740	PIPE COVER, .016" ALUM JACKT					
					13875.00 S.F.	
Unit values	0.13	0.54	2.59	0.00	0.00	3.13
Totals	1845.38	\$7,493	\$35,898	\$0	\$0	\$43,391
1562250180	THUNDERLINE GLAND SEAL FOR 6"DIA PIPE					
					318.00 Ea.	
Unit values	1.20	65.00	24.43	0.00	0.00	89.43
Totals	382.55	\$20,670	\$7,769	\$0	\$0	\$28,439
U15 MECHANICAL	4931	\$60,361	\$102,362	\$0	\$0	\$162,723

```

=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====

1621101460  OUTLET BOXES CAST, 2 GANG FS, DEADEND, 3/4"
            HUB, 1-11/16" DEEP
Unit values      0.80      14.99      19.05      0.00      53.00 Ea.      34.05
Totals          42.40      $795      $1,010      $0      $0      $1,805

1621101600  CAST FS BOX WEATHERPROF REC COVR
Unit values      0.13      9.02      2.98      0.00      53.00 Ea.      12.00
Totals          6.63      $478      $158      $0      $0      $636

1623202370  RECEPTACLES, PLUG, 30 AMP , FOR WEATHERPROOF OUTLET
Unit values      0.67      119.38      15.89      0.00      53.00 Ea.      135.27
Totals          35.35      $6,327      $842      $0      $0      $7,169

U16 ELECTRICAL      85      $7,600      $2,010      $0      $0      $9,610

```

```
=====
Line #      Description
-----
            Manhours   Matl      Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	5652	\$68,755	\$118,076	\$431	\$0	\$187,262
SALES TAX	0.00%		\$0			
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	22.00%		\$25,977			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	5.00%				\$0	
TOTAL BEFORE CONTINGENC		\$68,755	\$144,053	\$431	\$0	\$213,239
CONTINGENCY	20.00%					\$42,648
BOND	2.50%					\$5,331
PROFIT	10.00%					\$21,324
JOB TOTAL						\$282,541

```

=====
Estimate:      STEAM DIST. SYS      Date:      11-Nov-94
Description:   REPLACE SUMP PUMPS IN MANHOLES
Project:       LIMITED EEAP (WTR) Bid Date:
Location:      FORT KNOX, KY        Job #:      94013.03
Sq. footage:   POSTWIDE             City indx: Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl    Labor  Equipment  Sub      Total
=====
U02 SITEWORK      424          $0      $9,807      $425      $0      $10,232
U04 MASONRY       212          $794     $3,897        $6      $0      $4,697
U15 MECHANICAL   4931      $60,361   $102,362        $0      $0     $162,723
U16 ELECTRICAL    85          $7,600     $2,010        $0      $0      $9,610

TOTAL            5652      $68,755   $118,076     $431      $0     $187,262

SALES TAX         0.00%          $0
MATL MARKUP       0.00%          $0
LABOR MARKUP      22.00%          $25,977
EQUIPT MARKUP     0.00%          $0
SUB MARKUP        5.00%          $0

TOTAL BEFORE CONTINGENC $68,755   $144,053     $431      $0     $213,239
CONTINGENCY       20.00%          $42,648
BOND              2.50%          $5,331
PROFIT            10.00%          $21,324

JOB TOTAL                                     $282,541

```



**FY94S E P FT. KNOX WATER CONSERVATION STUDY  
CALCULATION WORK SHEET**

**FACILITY NO.:** Heating Distribution Manhole **DATE** 31 October 1994

**ECO Number 10 Sump Pump Replacement**

**Baseline**

Flooded manhole and wet pipe insulation increases heat loss.

Quantity	Manhole Heat Loss	Pipe Heat Loss	Annual Heat Loss/Manhole	Total Heat Loss
52	29.30 MWH	121.80 MWH	151.10 MWH	7,857.20 MWH

**Retrofit**

Dry manholes and pipe insulation decreases heat loss.

Quantity	Manhole Heat Loss	Pipe Heat Loss	Annual Heat Loss/Manhole	Total Heat Loss
52	3.46 MWH	14.28 MWH	17.74 MWH	922.48 MWH

**Savings**

$$\begin{array}{rcl}
 7,857.2 & - & 922.5 = \\
 & & 6,934.7 \text{ MWH per year} \\
 & & \$10.51 \text{ per MWH} \\
 & & \hline
 & & \$72,884 \text{ per year}
 \end{array}$$

**Proposed Retrofit**

Dewater, grout and replace sump pumps, insulation and pipe-to-wall penetration seals in heating distribution manholes.

**Savings Summary**

Annual Energy Savings of	6,935	mwh
Annual Energy Cost Savings of	\$72,884	
Annual Water Savings of	0	liters
Annual Water Cost Savings of	\$0	

## 9 FEMP PROJECT 3

FY94S WATER CONSERVATION STUDY (WATER AND ENERGY), FT. KNOX, KY

### FEMP PROJECT No. 3 - GOLF COURSE IRRIGATION WELL SYSTEM

The Anderson and Lindsey Greens are currently irrigated with potable water. The annual potable water consumption for the irrigation systems is 20,917,000 gallons. The annual cost for the potable water is \$19,670. The project will consist of disconnecting the existing potable water supply and drilling two wells, one for each golf course, to provide water for the irrigation systems. The construction cost is estimated to be \$33,527.

Below is a detailed index of the information included in this section:

Project LCCID Report . . . . .	9-2
Catalog Cut Sheet . . . . .	9-3
Project Cost Estimate . . . . .	9-4
Project Calculation Sheets . . . . .	9-11

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FEMP-3  
LCCID FY95 (92)

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: FEMP-3 GOLF COURSE IRRIGATION

FISCAL YEAR 1995      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 12-27-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	33527.		
B. SIOH	\$	1676.		
C. DESIGN COST	\$	1676.		
D. TOTAL COST (1A+1B+1C)	\$	36879.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)			\$	36879.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST \$/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 46.40	-9.	\$ -418.	15.08	\$ -6297.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 10.51	0.	\$ 0.	18.58	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.88	\$ 0.
N. TOTAL		-9.	\$ -418.		\$ -6297.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	7603.
(1) DISCOUNT FACTOR (TABLE A)	14.88		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	113133.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 113133.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 7185.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.13 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 106835.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.90  
(IF < 1 PROJECT DOES NOT QUALIFY)

\*\*\*\* Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

# Model VIT-CT

## Vertical Industrial Turbine Pump

- Capacities to 6000 GPM (1363 m<sup>3</sup>/h)
- Heads to 1400 feet (427m)
- Settings to 750 feet (229m)

### Design Advantages

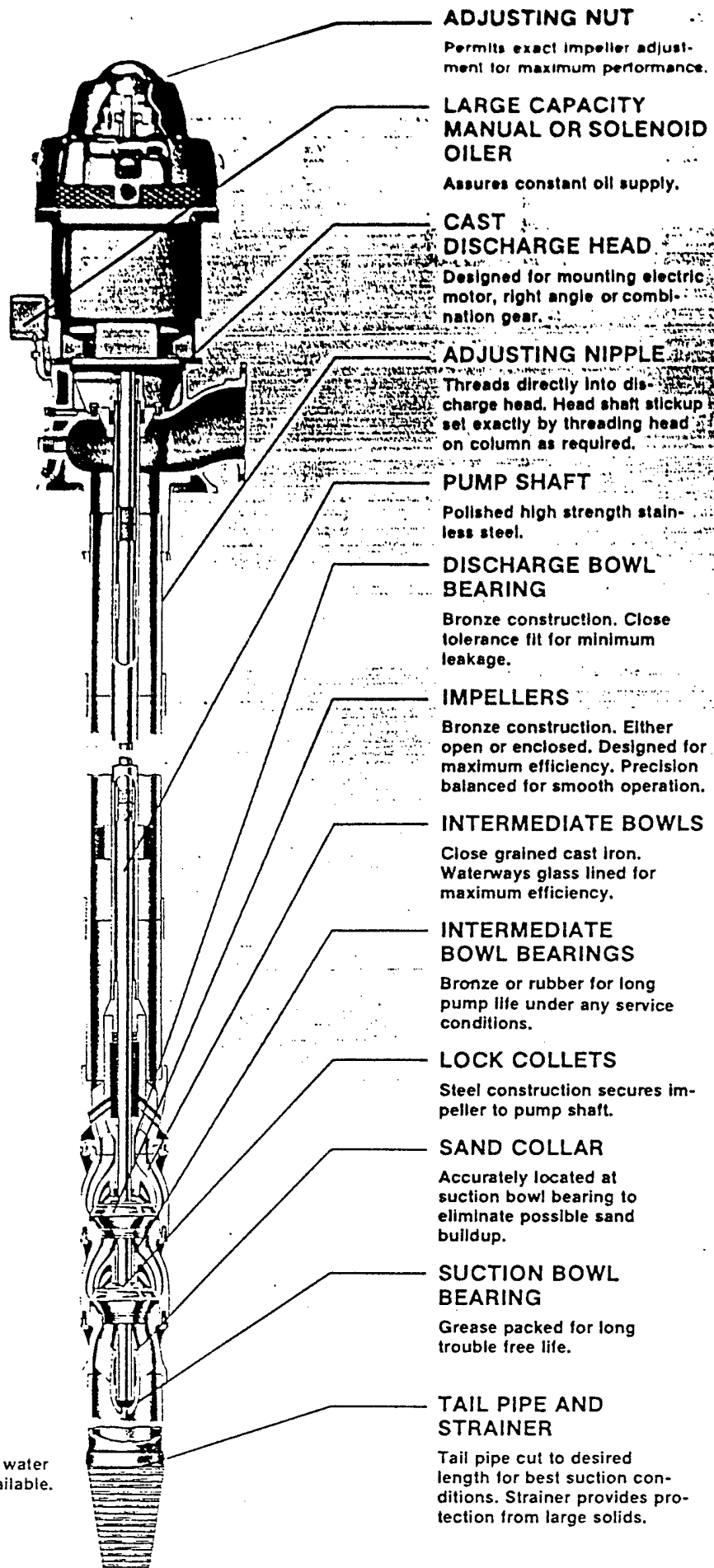
Cast discharge head with threaded column for low cost. Available with oil lube or water lubricated lineshaft; semi-open or closed impellers.

Pump selection is suited to meet every deep well application. Refer to pages 459, 460 for additional bowl assembly features/options.

### Services

Irrigation  
Fire Pumps  
Service Water  
Deep Well  
Drainage  
Municipal  
Water Supply

Oil lube lineshaft shown, water lube or open lineshaft available.



#### ADJUSTING NUT

Permits exact impeller adjustment for maximum performance.

#### LARGE CAPACITY MANUAL OR SOLENOID OILER

Assures constant oil supply.

#### CAST DISCHARGE HEAD

Designed for mounting electric motor, right angle or combination gear.

#### ADJUSTING NIPPLE

Threads directly into discharge head. Head shaft stickup set exactly by threading head on column as required.

#### PUMP SHAFT

Polished high strength stainless steel.

#### DISCHARGE BOWL BEARING

Bronze construction. Close tolerance fit for minimum leakage.

#### IMPELLERS

Bronze construction. Either open or enclosed. Designed for maximum efficiency. Precision balanced for smooth operation.

#### INTERMEDIATE BOWLS

Close grained cast iron. Waterways glass lined for maximum efficiency.

#### INTERMEDIATE BOWL BEARINGS

Bronze or rubber for long pump life under any service conditions.

#### LOCK COLLETS

Steel construction secures impeller to pump shaft.

#### SAND COLLAR

Accurately located at suction bowl bearing to eliminate possible sand buildup.

#### SUCTION BOWL BEARING

Grease packed for long trouble free life.

#### TAIL PIPE AND STRAINER

Tail pipe cut to desired length for best suction conditions. Strainer provides protection from large solids.

```

=====
Estimate:      IRRIGATION SYS      Date:      22-Dec-94
Description:    DRILL TWO NEW WATER WELLS
Project:        LIMITED EEAP (WTR) Bid Date:
Location:       FORT KNOX, KY      Job #:      94013.03
Sq. footage:    POST GOLF COURSE   City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 60 AMPERES					70.00 L.F.	
Unit values		0.15	2.62	5.02	0.00	0.00	7.64
Totals		10.43	\$183	\$352	\$0	\$0	\$535
A09 ELECTRICAL		11	\$183	\$352	\$0	\$0	\$535

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
0207080100	ELEC DEMO CONDUIT TO 15' HIGH GALV 1/2" TO 1" DIAM					
					40.00 L.F.	
Unit values	0.03	0.00	0.94	0.00	0.00	0.94
Totals	1.32	\$0	\$37	\$0	\$0	\$37
0207080370	ELEC DEMO, NON-METALIC SHEATHED CABLE (ROMEX) AVG. 50' RUN, #14-3					
					50.00 L.F.	
Unit values	0.01	0.00	0.34	0.00	0.00	0.34
Totals	0.60	\$0	\$17	\$0	\$0	\$17
0207242050	PLUM DEMO, METAL PIPING TO 4" DIAMTR					
					40.00 L.F.	
Unit values	0.05	0.00	1.55	0.00	0.00	1.55
Totals	2.12	\$0	\$62	\$0	\$0	\$62
0222582550	TRENCH EXCVTNG 40HP CHAIN TRNCHR&BKFIL 8"W36"D					
					50.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	0.50	\$0	\$12	\$12	\$0	\$24
0235540500	MOBILIZATION DRILL RIG, COMPLETE TO 36" MINIMUM					
					1.00 Ea.	
Unit values	24.00	0.00	508.86	827.54	0.00	1336.40
Totals	24.00	\$0	\$509	\$828	\$0	\$1,337
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					
					1.00 C.Y.	
Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.16	\$2	\$3	\$1	\$0	\$6
0260120500	BEDDING, PLACING IN TRENCH					
					1.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.09	\$0	\$2	\$1	\$0	\$3
0267040100	WELL, DOMESTIC, DRILLED & CASED, 4 TO 6" DIAM					
					400.00 V.L.F.	
Unit values	0.25	5.19	4.99	3.78	0.00	13.96
Totals	100.00	\$2,077	\$1,994	\$1,513	\$0	\$5,584
0267043000	WELL PUMP, INSTALLED, 25 TO 150' DEEP, 25' HP, 249 TO 297 GPM, 6" SUBMERSIBLE					
					2.00 Ea.	
Unit values	32.00	4885.02	841.22	467.74	0.00	6193.99
Totals	64.00	\$9,770	\$1,682	\$935	\$0	\$12,387
0293040310	FINE GRADING&SEEDING INCLUDING LIME, FERTILIZER&SEED, W EQUIP					
					8.00 S.Y.	
Unit values	0.05	0.10	0.99	0.21	0.00	1.29

22-Dec-94

MeansData for Lotus

Page 3

Totals

0.38

\$1

\$8

\$2

\$0

\$11

```

=====
Line #      Description
-----
              Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      194    $11,850    $4,326    $3,292        $0    $19,468

1517015620      PIPE STEEL THREADED SCH80 GALV 4"DIAM
Unit values      0.50      20.50      10.21      0.00      60.00 L.F.      30.71
Totals           30.00     $1,230      $613      $0        $0      $1,843

1517160180      PIPE CI ELBOW STD WT 90< BLK 4"DIAM
Unit values      2.67      42.00      54.47      0.00      12.00 Ea.      96.47
Totals           32.00      $504      $654      $0        $0      $1,158

1519907030      VALVE SEMI-STEEL, LUBRICATED PLUG, FLANGED 4"
DIAM
Unit values      5.33      277.00      108.94      0.00      2.00 Ea.      385.94
Totals           10.67      $554      $218      $0        $0      $772

U15 MECHANICAL    73      $2,288    $1,485      $0        $0      $3,773

```



```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====

1632500200  PANELBOARD CIRCUIT BREAKER BO 120 V 1P 60 A
              10K AIC
Unit values      1.00      9.12      23.82      0.00      0.00      32.94
Totals           2.00      $18      $48      $0      $0      $66

U16 ELECTRICAL      2      $18      $48      $0      $0      $66
```

```
=====
Line #      Description
-----
           Manhours   Matl     Labor   Equipment   Sub     Total
=====
```

ESTIMATE TOTAL	280	\$14,339	\$6,211	\$3,292	\$0	\$23,842
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	22.00%		\$1,366			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	5.00%				\$0	
TOTAL BEFORE CONTINGENC		\$14,339	\$7,577	\$3,292	\$0	\$25,208
CONTINGENCY	20.00%					\$5,042
BOND	3.00%					\$756
PROFIT	10.00%					\$2,521
JOB TOTAL						\$33,527

```

=====
Estimate:      IRRIGATION SYS      Date:      22-Dec-94
Description:   DRILL TWO NEW WATER WELLS
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY      Job #:      94013.03
Sq. footage:  POST GOLF COURSE  City indx: Louisville, KY
=====

```

## SUMMARY

```

-----
              Manhours   Matl       Labor    Equipment    Sub       Total
=====
A09 ELECTRICAL      11        $183        $352          $0          $0        $535
U02 SITEWORK       194      $11,850     $4,326      $3,292          $0      $19,468
U15 MECHANICAL      73        $2,288     $1,485          $0          $0      $3,773
U16 ELECTRICAL       2         $18         $48          $0          $0         $66

TOTAL              280      $14,339     $6,211      $3,292          $0      $23,842

SALES TAX           0.00%          $0
MATL MARKUP         0.00%          $0
LABOR MARKUP        22.00%        $1,366
EQUIPT MARKUP        0.00%          $0
SUB MARKUP           5.00%          $0

TOTAL BEFORE CONTINGENC $14,339     $7,577      $3,292          $0      $25,208
CONTINGENCY          20.00%          $5,042
BOND                  3.00%          $756
PROFIT               10.00%          $2,521

JOB TOTAL                                $33,527

```

FY94S EEAP FT. KNOX WATER CONSERVATION STUDY  
 CALCULATION WORK SHEET

DATE 31 October 1994

FACILITY NO.: Anderson Greens

ECO Number 7 Golf Course Irrigation

**Baseline**

Year	Month	Consumption	Cost
1993	Oct	976,000	\$918
1993	Nov	41,000	\$39
1993	Dec	0	\$0
1994	Jan	0	\$0
1994	Feb	0	\$0
1994	Mar	0	\$0
1994	Apr	0	\$0
1994	May	0	\$0
1994	Jun	1,801,000	\$1,695
1994	Jul	2,677,000	\$2,519
1994	Aug	1,350,000	\$1,270
1994	Sep	1,236,000	\$1,163
Annual Consumption		8,081,000	\$7,603

**Proposed Retrofit**

Install a non-potable water source for supplying irrigation water .  
 Annual potable water savings of 8,081,000 gallons  
 The system consists of a 100 foot deep well and a 25 hp submersible well pump.  
 500 annual operating hours.

25 horsepower
0.746 horsepower per kilowatt hour
500 hours per year
<hr/> 9321 kilowatt hours per year
\$0.0464 sales rate A
<hr/> \$432 annual energy cost

**FY94S EEAP FT. KNOX WATER CONSERVATION STUDY**

**CALCULATION WORK SHEET**

**DATE**

31 October 1994

**FACILITY NO.:**

Lindsey Greens

**ECO Number 7**

**Golf Course Irrigation**

**Baseline**

<b>Year</b>	<b>Month</b>	<b>Consumption</b>	<b>Cost</b>
1993	Oct	2,298,000	\$2,162
1993	Nov	89,000	\$84
1993	Dec	0	\$0
1994	Jan	0	\$0
1994	Feb	0	\$0
1994	Mar	0	\$0
1994	Apr	0	\$0
1994	May	0	\$0
1994	Jun	2,415,000	\$2,272
1994	Jul	3,772,000	\$3,549
1994	Aug	2,310,000	\$2,173
1994	Sep	1,952,000	\$1,837
<b>Annual Consumption</b>		<b>12,836,000</b>	<b>\$12,077</b>

**Proposed Retrofit**

Install a non-potable water source for supplying irrigation water .

Annual potable water savings of 12,836,000 gallons

The system consists of a 100 foot deep well and a 25 hp submersible well pump.

800 annual operating hours.

25 horsepower

0.746 horsepower per kilowatt hour

800 hours per year

---

14914 kilowatt hours per year

\$0.0464 sales rate A

---

\$692 annual energy cost

# *APPENDIX A*

## *Scope of Work*



DEPARTMENT OF THE ARMY  
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE  
CORPS OF ENGINEERS  
P.O. BOX 59  
LOUISVILLE, KENTUCKY 40201-0059

July 11, 1994

Contract Administration  
Branch

Systems Corporation  
2200 Sutherland Avenue  
Knoxville, TN 37919

Gentlemen:

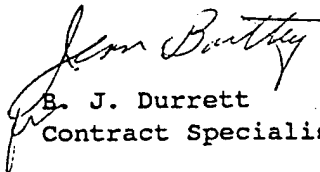
Reference is made to Indefinite Delivery Contract No. DACA01-94-D-0034, for architect-engineer services for the Energy Engineering Analysis Program (EEAP) for the midsouth region.

Enclosed is a General Scope of Work dated July 1, 1994, for a water conservation study (water and energy) at Ft. Knox, KY, for a delivery order under the above-referenced contract. Please submit your proposal no later than ten days after receipt of this letter. Return your proposal by mail to the U. S. Army Corps of Engineers, 600 Dr. Martin Luther King, Jr. Place, Room 821, Louisville, KY 40202-2230, or by fax at (502) 582-5266 or. Mark your proposal to the ATTENTION OF: CEORL-CT-C (W22W9K-4188-6247) DURRETT.

The enclosed "Profit Factor Determination" form should be submitted with your proposal. The "Release of Claims" form should be submitted after completion of the project along with your Final Pay Estimate.

If you have additional questions, please contact me at (502) 582-6796.

Sincerely,

  
B. J. Durrett  
Contract Specialist

Enclosures

CESAM-EN-CM  
CEORL-ED-M-S

January 1993  
July 1, 1994

GENERAL SCOPE OF WORK

FOR A

- a. WATER CONSERVATION STUDY (Water and Energy), and
- ~~b. LIMITED ENERGY STUDY (Glass)~~

FORT KNOX, KY

Performed as part of the  
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP) FY94S



FORT KNOX, KY  
SCOPE OF WORK  
FOR A  
a. WATER CONSERVATION STUDY (Water and Energy), and  
~~b. LIMITED ENERGY STUDY (Class)~~

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~~Energy Study (Class)~~
  - 7.3 Reevaluate Selected Projects
  - 7.4 Evaluate Selected ECOS
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  - 7.6 Submittals, Presentations and Reviews

ANNEXES

- A - DETAILED SCOPE OF WORK
- B - EXECUTIVE SUMMARY GUIDELINE
- C - REQUIRED DD FORM 1391 DATA
- GLOSSARY OF ACCRONYMS

1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (A/E) shall:

1.1 Review previously completed Energy Engineering Analysis Program (EEAP) study which applies to the specific building, and/or systems, or energy conservation opportunity (ECO) covered by this study, if any had been done.

1.2 Perform a Limited Energy survey (glass), and Water Conservation Study of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.

1.3 Reevaluate the specific project or ECO from the previous study, if any were done, to determine its economic feasibility based on revised criteria, current site conditions and technical applicability.

1.4 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.

1.5 Provide project documentation for recommended ECOs as detailed herein.

1.6 Prepare a comprehensive report to document all work performed, the results and all recommendations.

2. GENERAL

2.1 This study is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.

2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.

2.3 For the buildings, and/or systems or ECOs listed in Annex A, all methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.

2.4 The study shall consider the use of all energy sources applicable to each building, system, or ECO.

2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from AFPI-ENO, dated 20 JAN 1994 and the latest revision from CEHSC-FU establishes criteria for ECIP

projects and shall be used for performing the economic analyses of all ECOS and projects. The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis (LCCA), it must use the mode of calculation specified in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Contracting Officer.

2.6 Energy conservation opportunities (ECO) determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOS into larger packages which will qualify for ECIP, MCA, or PCIP funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOS.

2.6.1 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.6.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

2.6.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Engineering and Housing will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.

### 3. PROJECT MANAGEMENT

3.1 Project Managers. The A/E shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The A/E's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract.

3.2 Installation Assistance. The Commanding Officer or authorized representative at the installation will designate an individual to assist the A/E in obtaining information and establishing contacts necessary to accomplish the work required under this contract. This individual will be the installation representative.

3.3 Public Disclosures. The A/E shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The A/E's project manager and the Government's representative shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The A/E shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

### 3.6 Records

3.6.1 The A/E shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the A/E and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The A/E shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The A/E shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The A/E shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.7 Interviews. The A/E and the Government's representative shall conduct entry and exit interviews with the Department of Public Works (DPW) before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview

shall cover the following points:

- a. Schedules.
- b. Names of energy analysts who will be conducting the site survey.
- c. Proposed working hours.
- d. Support requirements from the Department of Public Works.

3.7.2 Exit. The exit interview shall briefly describe the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the DPW.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, supervision and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All ECOs which the A/E has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than \$300,000, a Savings to Investment Ratio (SIR) greater than one and a simple payback period of less than ten years. For ECAM projects, the \$300,000 limitation may not apply; in such cases, the AE shall check with the installation for guidance. The overall project and each discrete part of the project shall have an SIR greater than one. All projects meeting the above criteria shall be arranged as specified in paragraph 2.7.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented), and a Project Development Brochure (PDB). A LCCA summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. For projects and ECOs reevaluated from previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work under which the project or ECO was developed in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. The purpose of this information is to provide a

means to prevent duplication of projects in any future reports.

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate or payback period, but which have an SIR greater than one shall be documented. Projects or ECOS in this category shall be arranged as specified in paragraph 2.6.2 and shall be provided with the following documentation: the LCCA summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA, ie, energy savings calculations and cost estimate(s), and the simple payback period. The energy savings for projects consisting of multiple ECOS must take into account the synergistic effects of the individual ECOS. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost greater than \$3,000 but less than \$100,000 and a simple payback period of two years or less.

b. Productivity Enhancing Capital Investment Program (PE-CIP). This program is for projects which have a total cost of greater than \$3,000 but less than \$100,000 and a simple payback period of four years or less.

c. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost of more than \$100,000 and a simple payback period of four years or less.

The above programs and the required documentation forms are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than \$300,000 and a simple payback period of four to twenty-five years. Documentation shall consist of DD Form 1391 and a PDB.

e. Low Cost/No Cost Projects. These are projects which the DEH can perform using his resources. Documentation shall be as required by the DEH.

5.3 Nonfeasible ECOS. All ECOS which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The Detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. Review the previous EEAP study which applies to the specific building, system, or ECO covered by this study. This review should acquaint the AE with the work that has been performed previously. Much of the information the AE may need to develop the ECOs in this study may be contained in the previous study.

7.2 Perform Site Surveys. The A/E shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the A/E is encouraged to use any data that may have been documented in any previous study. The A/E shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.3 Reevaluate Selected Projects. The A/E shall reevaluate the projects and ECOs listed in Annex A. These are projects and ECOs that the previous study has identified but that have not been accomplished or only parts have been accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall then be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy savings, the energy costs and construction costs shall be updated, and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the AE shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

7.4 Evaluate Selected ECOs. The A/E shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. SIRs shall be determined using current ECIP guidance. The A/E shall provide all data and calculations needed to support the recommended ECO. All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A LCCA summary sheet shall be prepared for each ECO and included as part of the supporting data.

7.5 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph 7.6.1, the A/E will be advised of the DPW's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per paragraph 7.6.2.

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The A/E shall give a formal presentation of the interim submittal to installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the DPW, the A/E and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The results of the ECO analyses shall be summarized by lists as follows:

a. All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b. All ECOs which were analyzed shall be grouped into two listings, recommended and non-recommended, each arranged in



descending order SIR. These lists may be subdivided by building or area as appropriate for the study.

The A/E shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and A/E's representatives shall coordinate with the DPW to provide the A/E with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Final Submittal. The A/E shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The A/E shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph 7.6.1 shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (see Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects (includes LCCA Summary Sheets).

d. Appendices to include as a minimum:

- 1) Energy cost development and backup data
- 2) Detailed calculations
- 3) Cost estimates

- 4) Computer printouts (where applicable)
- 5) Scope of Work

LOUISVILLE DISTRICT CORPS OF ENGINEERS  
ENGINEERING DIVISION, A/E MANAGEMENT SECTION (CEORL-ED-M-S)

ANNEX A, a.  
DETAILED SCOPE OF WORK  
FORT KNOX, KY.  
July 1, 1994

1. PROJECT NAME & LOCATION: This is a FY94S Fort Knox EEAP  
a. Water Conservation Study. The study will identify and evaluate strategies for water conservation and energy conservation in the potable water system basewide which includes consideration for point of use, distribution, and operation. The study includes a survey and photo's in the various permanent buildings, and/or water systems areas that are summarized below as ECOS, as located in Figure A-1.1, and listed in Figure A-1.2.:

- Spring Loaded Faucets, basewide-Barracks, Shops, Admin
- Shower Heads, basewide- Barracks, Shops, Family Housing
- Water closets, hand washing/lavatory facilities, and flush valves water savers-sensors, basewide- Barracks, Shops, Admin, and Family Housing.
- Distribution waterline motors, valves, leaks, storage tanks, off peak, and capacities basewide.
- Vehicle wash facilities, and 2 Golf courses watering systems.
- Dining Facilities equipment and leaks, basewide, that includes electric energy savings(lights,sensors, etc.)
- Post Laundry
- Central steam boiler plants and leaks, basewide
- Hospital, process cooling, i.e. such as x-ray and cat-scan equipment, and leaks
- Cooling towers, basewide
- Water treatment plants

2. GENERAL SOW vs. DETAILED SOW: The General Scope of Work (GSOW) will apply to contract efforts as modified by the Detailed SOW. Should conflicts occur between the GSOW and the Detailed SOW, the Detailed SOW shall govern.

3. RESPECTIVE POC's for this study:

Louisville District COE-Charles(Chuck) Lockman/CEORL-ED-M-S  
(502) 582-6041, fax# 6763, or 5281

Fort Knox, KY DPW-Gary Meridith/DPW Energy Officer, or Kevin Addison  
(502) 624-6828, fax# 3679

A/E- Ned(Chuck) Belt, or Keith Derrington  
DACA01-94-D-0034 Systems Corp., Suite 306, Cherokee Pl  
(Mobile) 2200 Sutherland Avenue  
Knoxville, TN 37919  
(615) 521-6536, or FAX# 524-7514

4. SCOPE:

4.1 The A/E shall provide all work necessary to complete the Water Conservation Study as defined by the GSOW including the annexes. Information and instructions contained within the SOW are provided as a means for the A/E Project Manager to expand or modify the GSOW as may be needed to suit the study for the ECOS project areas listed in par. 1. above. This study is much more flexible than the standard EEAP ESOS type study, and is meant to address specific opportunities, buildings and/or systems that the installation feels have high and low potential for energy or dollar savings. Water conservation may be considered high project on a low return dollar wise.

4.2 The study will analyze all water conservation survey ECOS as listed in par. 1. above and as listed in Figure A-1.2.

4.3 The study will consider new designs, for energy saver trenders in equipment that make these facilities more cost effective, water saving, and energy saving.

4.4 If metering of a facility is required, the A/E shall assist the DPW in arranging for the installation of electrical or water metering, however, existing data is available at the installation, and by other studies/ surveys.

5. DETAILED REQUIREMENTS: All detail requirements selected at Fort Knox for the purpose of this study, shall specifically include the specific facilities listed in par, 1. above and projects identified by the DPW staff.

In general, the facilities and projects, when investigated relative to the ECO's provided as follows:

The contractor will review existing building drawings, existing water maps, survey and monitor existing water systems, and analyze the listed ECO's, and analyze additional ECO's readily discoverable during the field survey.

6. PERFORMANCE: The total time required for completion of the study and the performance of all work shall not be more than 180 calendar days from the Notice to Proceed (NTP) on the contract. If the study takes the A/E less time than scheduled to achieve, a shortened schedule for submittal and coordination of review and interim review meeting at the installation may be coordinated by the A/E with all parties involved in the review process. Figure A-6.1. Schedule of pertinent events and milestone dates for acceptable performance of the study at Fort Knox. Changes or adjustments made to the SOW during the term of the project study shall be make by the COE.

7. SUBMITTAL: The A/E's Project Manager shall provide direct distribution of all required submittal and documents in the numbers as listed in Figure A-7.1.

8. GOVERNMENT-FURNISHED INFORMATION: The following list of

A-2

reference documents will be furnished to the A/E:

a. Energy Conservation Investment Program (ECIP) Guidance, dated 20 Jan 1994,

b. TM 5-785, Engineering Weather Data.

c. AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

d. AR 415-15, 1 Jan 84, Military Construction, Army (MCA) Program Development.

e. The latest MCP Index.

f. Drawings or Master Plan Existing Conditions at the DPW of each facility, if available.

9. LCCID FROM BLAST: A computer program titled Life Cycle Costing in Design (LCCID) will be used and is available from the BLAST Support Office in Urbana, Illinois for a nominal fee. This computer program will be used for performing the economic calculations for ECIP and non-ECIP ECOs. The A/E is encouraged to obtain and use this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. The telephone number is (217) 333-3977, or (800) 842-5478.

10. If it is possible that the buildings in this study will be subject to the computer modeling requirements of paragraph 2.6 of the GSOW, then the simulation programs acceptable to the office doing the technical review should be listed in the detailed scope of work. Some acceptable simulation programs follow:

a. Building Loads and System Thermodynamics (BLAST) \*

b. DOE 2.1B \*

c. Carrier E20 or Hourly Analysis Program (HAP) \*\*

d. Trane Air-Conditioning Economics (TRACE) \*\*

\* Very accurate, but requires a lot of time for input; therefore it is rather expensive for straightforward projects.

\*\* Adequate for load determination, equipment selection, and energy performance for most projects.

FIGURE A-1.2 BUILDING AND/OR SYSTEMS LIST:

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP) FY94:  
FY94S EEAP FORT KNOX

a. WATER CONSERVATION STUDY

BUILDINGS/SYSTEMS LIST

- Spring Loaded Faucets, basewide-Barracks, Shops, Admin.

No.	Series	Cat C	Short Title
all	721		Unaccompanied Personnel Housing Enlisted
all	723		Unaccompanied Personnel Housing Detached Facilities
all	724		Unaccompanied Personnel Housing Officers
all	730		Community Facilities Personnel Support & Service
all	740		Community Facilities Morale, Welfare, & Recreat. Inter
all	600		Administrative Facilities
all	214		Maintenance-Tank, Automotive
all	211		Maintenance-Aircraft
all	171		Training Buildings
all	219		Maintenance-Installation, Repair, & Operation

- Shower Heads, basewide- Barracks, Shops, Family Housing

No.	Series	Cat C	Short Title
all	721		Unaccompanied Personnel Housing Enlisted
all	723		Unaccompanied Personnel Housing Detached Facilities
all	724		Unaccompanied Personnel Housing Officers
all	730		Community Facilities Personnel Support & Service
all	740		Community Facilities Morale, Welfare, & Recreat. Inter
all	600		Administrative Facilities
all	214		Maintenance-Tank, Automotive
all	211		Maintenance-Aircraft
all	171		Training Buildings
all	219		Maintenance-Installation, Repair, & Operation
all	711		Family Housing Dwellings

- Water closets, hand washing facilities, lavatories, and flush valves water savers-sensors, basewide- Barracks, Shops, Admin., and Family Housing.

No.	Series	Cat C	Short Title
all	721		Unaccompanied Personnel Housing Enlisted
all	723		Unaccompanied Personnel Housing Detached Facilities
all	724		Unaccompanied Personnel Housing Officers
all	730		Community Facilities Personnel Support & Service
all	740		Community Facilities Morale, Welfare, & Recreat. Inter
all	600		Administrative Facilities
all	214		Maintenance-Tank, Automotive
all	211		Maintenance-Aircraft
all	171		Training Buildings
all	219		Maintenance-Installation, Repair, & Operation
all	711		Family Housing Dwellings

● Distribution waterline motors, valves, leaks, storage tanks, off peak, and capacities basewide.

Series

No.	Cat	C	Short Title
all	841		Water Supply, Treatment, and Storage Potable
all	842		Water Distribution System Potable

● Vehicle wash facilities, and 2 Golf courses watering systems.

Series

No.	Cat	C	Short Title
all	214		Maintenance-Tank, Automotive
all	211		Maintenance-Aircraft
all	219		Maintenance-Installation, Repair, & Operation

● Dining Facilities equipment and leaks, basewide

Series

No.	Cat	C	Short Title
all	721		Unaccompanied Personnel Housing Enlisted
all	723		Unaccompanied Personnel Housing Detached Facilities
all	724		Unaccompanied Personnel Housing Officers
all	722		Unaccompanied Personnel Dining Facilities

● Post Laundry Facility

Series

No.	Cat	C	Short Title
all	730		Post Laundry

● Central steam boiler plants and leaks, basewide

Series

No.	Cat	C	Short Title
all	821		Heat/Source
all	822		Heat Transmission and Distribution Lines

● Hospital, process cooling and leaks

Series

No.	Cat	C	Short Title
all	510		Hospital and Medical Facilities

● Cooling towers, basewide

Series

No.	Cat	C	Short Title
all	820		Heat and Refrigeration (Air Conditioning)
all	826		Refrigeration (Air Conditioning) Source
all	827		Chilled Water (Air Conditioning) Trans & Distrib.

● Water treatment plants, basewide

Series

No.	Cat	C	Short Title
all	841		Water Treatment Plant

FIGURE A-6.1. SCHEDULE for a. Water Conservation Study, and ~~b. Limited Energy Study (Glass)~~ FY94S EEAP, Fort Knox, KY are as follows if awarded together:

<u>Item</u>	<u>Calendar</u>	<u>ActualDate</u>
a. COE SOW meeting w/Energy Officer.....TBD		Jun 14, 94
b. COE finishes DSOW for FK review.....TBD		Jul 01, 94
c. FK review ends and meets w/COE.....TBD		Jul 15, 94
d. COE visits FK to collect Scope changes/adds..		Jul 18, 94
e. COE Revises SOW .....TBD		Jul 21, 94
1. RFP LETTER TO A/E.....TBD	..	Jul 25, 94
2. RFP LETTER RECEIVED BY A/E.....TBD (COE, DPW, and A/E coordinates date)	..	Jul 25, 94
3.a. A/E Submits Proposal FAX'd/Neg'ns begin....TBD	..	Jul 28, 94
b. SOW formal mtg. @ FK, or Tel. conf.call....TBD	..	Jul 28, 94
4. Award of Contract-Start Up/NTP (SAF).....1	..	Aug 01, 94
5. ENTRY INTERVIEW @ Fort Knox, KY .....1	..	Aug 01, 94
6. INTERIM SUBMITTAL @ 60%.....100 (all field work completed/ECO's analyzed)	..	Nov 01, 94
7. REVIEW PERIOD OF THE INTERIM SUBMITTAL.....120 (COE gathers comments from IN-HOUSE/DPW/MACOM)	..	Nov 20, 94
8. INTERIM REVIEW MEETING @ FK.....130 (COE, DPW, A/E, & others)	..	Nov 30, 94
9. EXIT INTERVIEW MTG. @ FK.....130	..	Nov 30, 94
10. FINAL SUBMITTAL.....160 (A/E sends directly to as listed, herein)	..	Dec 30, 94
11. DPW may require to have input on the DD 180 Form 1391 from A/E	..	Jan 01, 94
12. DPW SUBMITS DD Form 1391's.....TBD		



FIGURE A-7.1. Distribution of Submittals: The A/E shall make direct submittal and responses to comments as indicated by the following schedule:

<u>Organization</u>	<u>Correspondence</u>	<u>Executive Summary</u>	<u>Reports</u>	<u>Fieldnotes</u>
COMMANDER, US Army Engineer District, Louisville ATTN: CEORL-ED-M-S/Charles Lockman P.O. Box 59 (express-600 Dr. Martin King Place) Louisville, KY 40201-0059 tel. (502) 582-6041, or fax# 6763, or 5281	1	1	1	1*
COMMANDER, US Army Armor Center & Fort Knox ATTN: ATZK-EH-PS/Gary Meredith, Energy Officer Building 77 Fort Knox, KY 40121-5000 tel. (502) 624-8358 or fax# 3679	1	1	1	1*
HQ TRADOC (MACOM) ATTN: ATBO-GFE/Al Betcher Fort Monroe, VA 23651-5000 tel. (804) 727-2453, or fax# 2362	1	1	1	1*
COMMANDER, US Army Engineer District, Mobile ATTN: CESAM-EN-CC/Tony Battaglia (EEAP TCX) P.O. Box 2288 Mobile, AL 36628-0001 tel. 205-690-2618, or fax# 2424	0	1**0		0
COMMANDER, US Army Engineer Div., Ohio River ATTN: CEORD-DL-M/Joe Semrad P.O. Box 1159 Cincinnati, OH 45201-1159 tel. 513-684-3975	0	1**0		0
COMMANDER, US Army Corps of Engineers ATTN: CEMP-ET/Dan Gentil (EEAP Mgr.) 20 Massachusetts Avenue Washington, D.C. 20314-1000 tel. 202-272-8622	0	1**0		0
COMMANDER, US Army Logistics Evaluation Agency ATTN: LOEA-PL/Mr. Keath New Cumberland Army Depot New Cumberland, Pa. 17070-5006	0	1**0		0

\* Field Notes submitted in final at Interim submittal.

\*\* Submit copies of the final Executive Summary Only

## ANNEX B

### EXECUTIVE SUMMARY GUIDELINE

1. Introduction.
2. Building Data (types, number of similar buildings, sizes, etc.)
3. Present Energy Consumption of Buildings or Systems Studied.

- o Total Annual Energy Used.
- o Source Energy Consumption.
  - Electricity - KWH, Dollars, BTU
  - Fuel Oil - GALS, Dollars, BTU
  - Natural Gas - THERMS, Dollars, BTU
  - Propane - GALS, Dollars, BTU
  - Other - QTY, Dollars, BTU

4. Reevaluated Projects Results.

5. Energy Conservation Analysis.

- o ECOS Investigated.
- o ECOS Recommended.
- o ECOS Rejected. (Provide economics or reasons)
- o ECIP Projects Developed. (Provide list)\*
- o Non-ECIP Projects Developed. (Provide list)\*
- o Operational or Policy Change Recommendations.

\* Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date.

6. Energy and Cost Savings.

- o Total Potential Energy and Cost Savings.
- o Percentage of Energy Conserved.
- o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

ANNEX C

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

- a. In title block clearly identify projects as "ECIP."
- b. Complete description of each item of work to be accomplished including quantity, square footage, etc.
- c. A comprehensive list of buildings, zones, or areas including building numbers, square foot floor area, designated temporary or permanent, and usage (administration, patient treatment, etc.).
- d. List references, and assumptions, and provide calculations to support dollar and energy savings, and indicate any added costs.
  - (1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage, floor area, window and wall area for each exposure.
  - (2) Identify weather data source.
  - (3) Identify infiltration assumptions before and after improvements.
  - (4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.
- e. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.
- f. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures is not considered an ECIP type project.
- g. An ECIP life cycle cost analysis summary sheet as shown in the ECIP Guidance shall be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were

determined shall be included.

h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple amortization period and a statement attesting that all buildings and retrofit actions will be in active use throughout the amortization period.

i. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.

j. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable and (3) an economic analysis supporting the specific retrofit.

k. Nonappropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are not reimbursable.

l. Any requirements required by ECIP guidance dated 4 Nov 1992 and any revisions thereto. Note that unescalated costs/savings are to be used in the economic analyses.

m. The five digit category number for all ECIP projects except for Family Housing is 80000. The category code number for Family Housing projects is 71100.

## GLOSSARY OF ACRONYMS

A/E	Architect Engineer
AR	Army Regulation
B/C	Benefit to Cost
COE	Corps of Engineers
CWE	Current Working Estimate
DPW	Director of Public Works
DOD	Department of Defense
DSOW	Detailed Scope of Work
E/C	Energy to Cost
ECAM	Energy Conservation and Management
ECIP	Energy Conservation Investment Program
ECO	Energy Conservation Opportunity
EEAP	Energy Engineering Analysis Program
EHSC	Engineering and Housing Support
EMCS	Energy Monitoring Analysis Program
ESOS	Energy Savings Opportunity Survey
GSOW	General Scope of Work
HQUSACE	Headquarters US Army Corps of Engineers
LCCA	Life Cycle Cost Analysis
LCCID	Life Cycle Cost In Design
MACOM	Major Army Command
MCA	Military Construction Army
NECPA	National Energy Conservation Policy Act
OSD PIF	OSD Productivity Capital Investment Funding
PCIP	Productivity Capital Investment Program
PDB	Project Document Brochure
PECIP	Productivity Enhancing Capital Investment Program
POC	Point of Contact
QRIP	Quick Return on Investment Program
SIR	Savings Investment Ratios
TCX	Technical Center of Expertise

RELEASE OF CLAIMS

The undersigned architect-engineer firm, under Contract No. \_\_\_\_\_, dated \_\_\_\_\_, 19\_\_\_\_, between the United States of America and said architect-engineer for \_\_\_\_\_, located at \_\_\_\_\_, in accordance with the "Payment" clause of said contract, hereby releases the United States, its officers, agents, and employees from any and all claims arising under or by virtue of said contract or any modification or change thereof except with respect to those claims, if any, listed below:

Executed this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(title)

Witness:

\_\_\_\_\_  
(address)

\_\_\_\_\_  
(address)

## *APPENDIX B*

### *Interim Review Comments and Responses*

<b>Project Review Comments</b>	Interim <input checked="" type="checkbox"/> Pre-Final <input type="checkbox"/> Final <input type="checkbox"/>	Project: <b>Water Conservation Study (Water and Energy)</b> Location: <b>Fort Knox, KY</b> Year: <b>1994</b>	Reviewer: <b>CEORL-ED-D-M</b> Name: <b>Kerry Prather</b> Organizer:	Page 1 of <u>1</u> Date: <u>11/23/94</u>
--------------------------------	---------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------	---------------------------------------------

Comment No.	Vol.	Sec.	Page	COMMENTS <small><input type="checkbox"/> Struc. <input type="checkbox"/> Arch. <input type="checkbox"/> Civ. <input type="checkbox"/> Mech. <input type="checkbox"/> Elec. <input type="checkbox"/> San. <input type="checkbox"/> Env. <input type="checkbox"/> Fire <input type="checkbox"/> Other</small>	Action Code	RESOLUTIONS (include location of documents)	Ref.
1				<u>General:</u> Method of calculating savings is acceptable and logical	A	No response required.	
2	2,3	ECO-1		Savings shown for ECO-1 cannot be calculated from information shown. Please verify accuracy of calculated savings. Some values are approximately 25% higher than calculated values. Is this due to the estimated 25% less time faucets are on with spring loaded fixtures? Why are other values increased by less than 25%?	A	The faucets are generally estimated to be running 25% less due to the metering valves. In some instances the estimated savings were increased due to leaks that were found during the survey.	

ACTION CODES:      D - Action Deferred      N - Non-concur      VE - VE Potential/VEP Attached      W - Withdrawn

A - Accepted/Concur



<b>Project Review Comments</b>		Interim <input checked="" type="checkbox"/> Pre-Final <input type="checkbox"/> Final <input type="checkbox"/>	Project: <b>Water Conservation Study (Water and Energy)</b> Location: <b>Fort Knox, KY</b> Year: <b>1994</b>	Reviewer: <b>CEORL-ED-MS</b> Name: <b>Charles Lockman</b> Organizer:	Page 1 of <u>1</u> Date: <u>11-23-94</u>
--------------------------------	--	---------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------	---------------------------------------------

Comment No.	Vol.	Sec.	Page	COMMENTS <input type="checkbox"/> Struc. <input type="checkbox"/> Arch. <input type="checkbox"/> Civ. <input type="checkbox"/> Mech. <input type="checkbox"/> Elec. <input type="checkbox"/> San. <input type="checkbox"/> Env. <input type="checkbox"/> Fire <input type="checkbox"/> Other	Action Code	RESOLUTIONS (include location of documents)	Ref.
1	1	13	13-1	ECO-7, Golf Course - Does this include both courses, Lindsey and Anderson?	A	ECO-7 does include both golf courses. ECO-7 has been developed into FEMP Project No. 3, the project development information for the project is in Section 9.0 of the report. The project description has been written to clearly indicate both Anderson and Lindsey Greens are in the project scope.	
2	1	TOC/3	i, ii/3,4	ECO-5, Water Saving Showerheads - ECO is listed but not recommended or recommended. What happened to it?	A	The information was omitted from the Interim Report. It is located in Section 2.1.2.1. ECO-5, Water Saving Showerheads, was eliminated from consideration, since water saving showerheads are all ready in place.	

ACTION CODES: A - Accepted/Concur      D - Action Deferred      N - Non-concur      VE - VE Potential/VEP Attached      W - Withdrawn

<b>Project Review Comments</b>		Interim <input checked="" type="checkbox"/> Pre-Final <input type="checkbox"/> Final <input type="checkbox"/>	Project: <b>Water Conservation Study (Water and Energy)</b> Location: <b>Fort Knox, KY</b> Year: <b>1994</b>	Reviewer: <b>CESAM-EN-DM</b> Name: <b>Tony Battaglia</b> Organizer:	Page 1 of <u>2</u> Date: <u>12-12-94</u>
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Comment No.	Vol.	Sec.	Page	COMMENTS <input type="checkbox"/> Struc. <input type="checkbox"/> Arch. <input type="checkbox"/> Civ. <input type="checkbox"/> Mech. <input type="checkbox"/> Elec. <input type="checkbox"/> San. <input type="checkbox"/> Env. <input type="checkbox"/> Fire <input type="checkbox"/> Other	Action Code	RESOLUTIONS (include location of documents)	Ref.
1	1	TOC		There appears to be a conflict between the Table of Contents and the titles of Appendices B and C in Volume IV. Please check and correct.	A	We concur. Corrections will be made.	
2	1	2	2-1	The last sentence on page 2-1 leads the reader to expect to turn the page and find a list of 15 energy conservation opportunities; instead one finds Tables 2.1.1 and 2.1.2. There are several ways that this could be avoided. Please clarify.	A	We concur. The tables will be relocated in the Final Report.	
3	1	2	2-18	Par 2.4.4: This paragraph states that the cooling tower does not have an automatic blowdown system, and therefore there are no water saving opportunities. All cooling towers employ some type of water treatment; and all employ some method of bleed-off or blowdown to keep total dissolved solids within reasonable limits. Please review and investigate further if needed, or clarify the statement.	A	The information in the Interim Report, pg. 2-18, Paragraph 2.4.4, is incorrect. The cooling tower does have automatic blow down systems. The cooling towers were evaluated for conversion from chemical water treatment to ozone water treatment. The cooling towers are only in service six months of the year. The analysis yielded a simple payback of greater than ten years. The ozone water treatment system would have paid back in less than ten years if the cooling towers operated twelve months of the year, since the blowdown water savings and chemical savings would have been significantly increased.	

Project Review Comments	Interim <input checked="" type="checkbox"/> Pre-Final <input type="checkbox"/> Final <input type="checkbox"/>	Project: <b>Water Conservation Study (Water and Energy)</b>	Reviewer: CESAM-EN-DM Name: Tony Battaglia Organizer:	Page 2 of 2 Date: 12-12-94
		Location: <b>Fort Knox, KY</b> Year: <b>1994</b>		

Comment No.	Vol.	Sec.	Page	COMMENTS <input type="checkbox"/> Struc. <input type="checkbox"/> Arch. <input type="checkbox"/> Civ. <input type="checkbox"/> Mech. <input type="checkbox"/> Elec. <input type="checkbox"/> San. <input type="checkbox"/> Env. <input type="checkbox"/> Fire <input type="checkbox"/> Other	Action Code	RESOLUTIONS (Include location of documents)	Ref.
4	1	3		As discussed in the preface to Section 3, the AE has done an excellent job of organizing, evaluating, and manipulating large amounts of data. Par 3.2 discusses calculations; and it is agreed that standardized spreadsheets should be used to assure uniformity. However, the discussion on calculations is really not complete until the basic assumptions and equations have been presented. Refer to par 7.4 in the General Scope of Work. One page for each of the ECOs investigated should be sufficient to state assumptions and show the equations used. Manufacturers' catalog cuts or other back-up data can be used to substantiate claims for water usage for various products proposed. The validity of the study cannot really be evaluated until this has been done.	A	In the subsections of section 2.2 of the Final Report, the methods used for calculating the water and energy conservation opportunities have been described in greater detail. Manufacturers catalog cuts have been included in the project development information for the four ECIP and three FEMP projects. The project development information is located in Sections 3 through 9 of the Final Report.	
5	4	B	B-1	The Calculation Work Sheet for ECO No. 7, Golf Course Irrigation, generated several questions: a. What assurances are there that there is sufficient ground water available for this use? b. What is the water table? c. What is the well casing size? d. On what basis was the pump selected? e. Provide a catalog cut for a typical pump that would be used for this purpose.	A	The U.S. Geological Service and the Environmental Section of the DPW at Ft. Knox were consulted regarding the availability and depth of the groundwater. The water table is estimated to be between 80 and 100 feet below the surface. The wells are estimated at depth of 200 feet each with six inch casings. The well pump was selected based upon the sum of the head requirements to bring water to the surface and the residual pressure required to distribute the water through the irrigation distribution piping with a discharge pressure of 40 PSIG. A catalog cut sheet for the pump is located in Section 9 of the Final report.	

ACTION CODES:  
A - Accepted/Concur

D - Action Deferred

N - Non-concur

VE - VE Potential/VEP Attached

W - Withdrawn

# SYSTEMS<sub>corp</sub>

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION

December 30, 1994

Commander, US Army Engineer District, Louisville  
ATTN: CEORL-ED-M/Charles Lockman  
P. O. Box 59  
Louisville, KY 40201-0059

Dear Mr. Lockman:

Re: FY94 Fort Knox EEAP Water Conservation Study Interim Review Meeting  
Contract No. DACA-01-94-0034

The Fort Knox Water Conservation Study Interim Review Meeting was held on 29 November 1994 at Fort Knox. The following are additional comments and decisions reached during the meeting:

Tuesday, 29 November 1994  
Persons Present:

Kevin N. Addison	DPW, EP&S	Sonja Brown	DPW, EP&S/Energy
Charles Lockman	CEORL-ED-MS	Jenni O'Dwyer	COE
Paul E. Frye, Jr.	DPW, EPSD	Charley Belt	Systems Corp
Gary T. Meredith	DPW, EP&S/Energy	Keith Derrington	Systems Corp

- The Family Housing units will be broken out as three (3) separate projects so that each project will represent and investment of \$1,000,000. The projects will be grouped according to geographic location. The Prichard Place blocks will be omitted from the projects.
- The golf course irrigation system will be a separate project. The steam manhole sump pumps will be a separate project as well.
- Metering for the water plants will be included in ECOs 1, 3, 4 and 6.
- Included in the report are cut sheets of recommended products for retrofit to existing plumbing fixtures, water closet replacement, sump pump replacement and well pumps for the golf course irrigation system.

If you have any questions or comments regarding this material, please do not hesitate to contact me at 615-521-6536.

Sincerely,



Keith A. Derrington, P.E.

/rsg

## *APPENDIX C*

### *Interim Review Presentation*

# Work Accomplished to Date

- Field Survey Completed
- Preparation and Completion of Field Notes
- Baseline Water and Energy Conservation Calculations
- Evaluation of 16 Water and Energy Conservation Opportunities
- Completion of LCCAs
- Completion of Interim Report

# Energy/Water Conservation Opportunities

ECO-1	Spring Loaded Faucets
ECO-2	Faucet Aerators
ECO-2FH	Faucet Aerators
ECO-3	Flush Valve Replacements for Water Closets
ECO-3FH	Water Closet Replacement
ECO-4	Flush Valve Replacements for Urinals
ECO-5	Water Saving Showerheads
ECO-6	Dining Facilities Kitchen Areas
ECO-7	Golf Course Irrigation
ECO-8	Post Laundry

## Energy/Water Conservation Opportunities (Cont.)

ECO-9	Waste Treatment Plants and Well Fields, Motors, and Pumps
ECO-10	Manhole Sump Pump Repairs
ECO-11	Sensor Controls for Faucets
ECO-12	Water Heater Insulation Blankets
ECO-13	Distribution Waterline Motors, Valves, Leaks, Storage Towers and Tanks, Off Peak, and Capacities
ECO-14	Hospital, Process Cooling and Leaks
ECO-15	Vehicle Wash Facilities
ECO-16	Cooling Towers at Hospital



# Energy and Water Costs

Electric + \$0.02505/KWH (\$25.05/MWH)

Fuel Oil = \$5.05/MBtu (\$17.15/MWH)

Natural Gas = \$3.10/MBtu (\$10.51/MWH)

Water = \$0.9409/KGal (\$0.249/Kliter)

Sewage = \$0.6292/KGal (\$0.160/Kliter)

# Recommended ECOs

ECO-1	ECO-4
ECO-2	ECO-6
ECO-2FH	ECO-7
ECO-3	ECO-8
ECO-3FH	ECO-10

# ECO-1: Spring Loaded Faucets

Cost: \$897,796

Discounted Savings : \$44,028,379

SIR: 49.04

## ECO-2: Faucet Aerators

Cost: \$3,403

Discounted Savings : \$21,066,900

SIR: 6,190.68

# ECO-2FH: Faucet Aerators

Cost: \$2,668

Discounted Savings : \$11,342,778

SIR: 4,251.42

## ECO-3: Flush Valve Replacements for Water Closets

Cost: \$139,965

Discounted Savings : \$457,713

SIR: 3.27

# ECO-3FH: Water Closet Replacement

Cost: \$3,043,912

Discounted Savings : \$7,131,284

SIR: 2.34

## ECO-4: Flush Valve Replacements for Urinals

Cost: \$103,381

Discounted Savings : \$262,647

SIR: 2.54



## ECO-6: Dining Facilities Kitchen Areas

Cost: \$198

Discounted Savings : \$931,393

SIR: 4,704.00

# ECO-7: Golf Course Irrigation

Cost: \$21,832

Discounted Savings : \$105,317

SIR: 4.82

## ECO-8: Post Laundry

Cost: \$28,556

Discounted Savings : \$1,475,400

SIR: 51.67

## ECO-10: Manhole Sump Pump Repairs

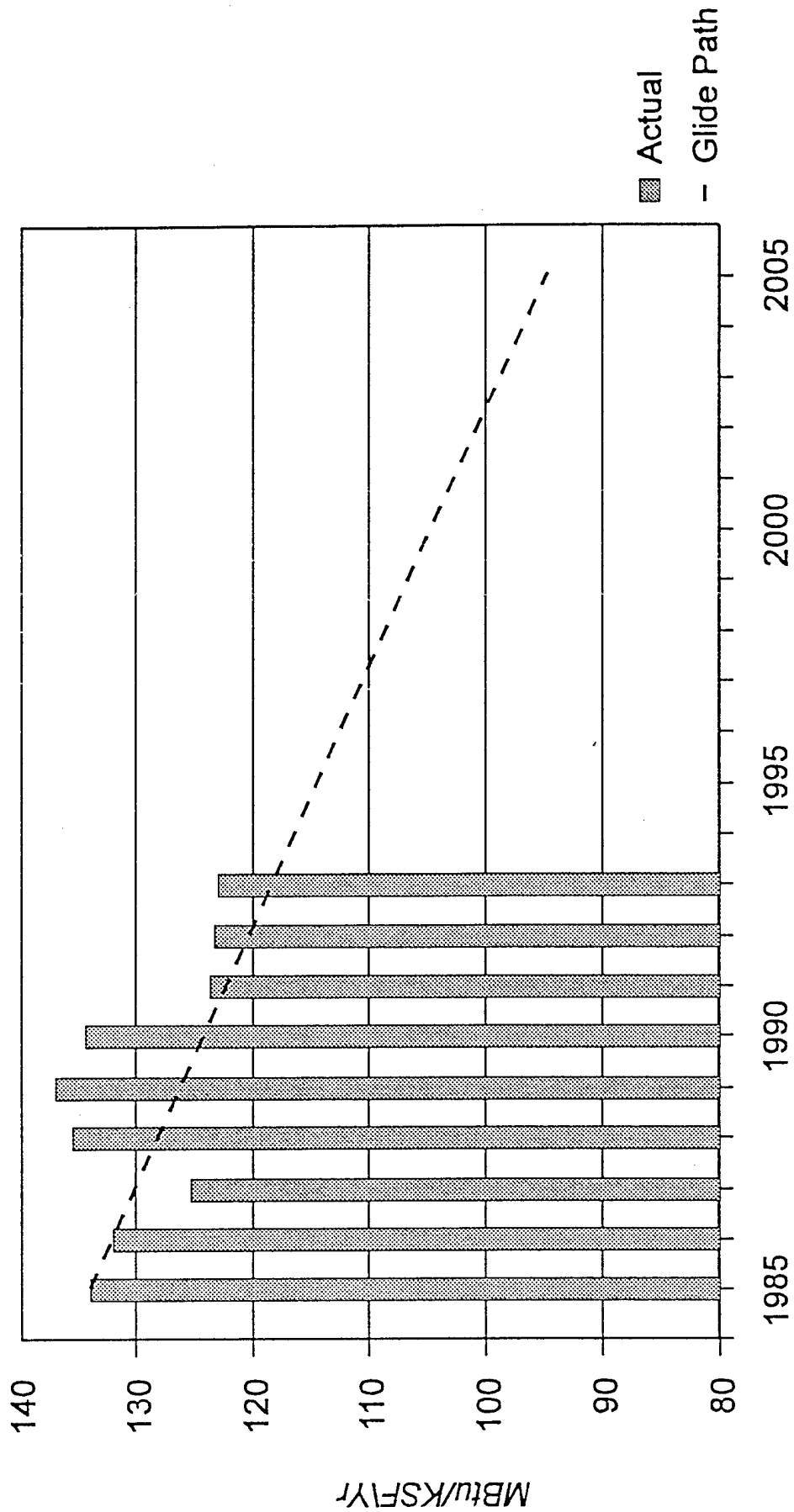
Cost: \$247,186

Discounted Savings : \$1,527,708

SIR: 6.18

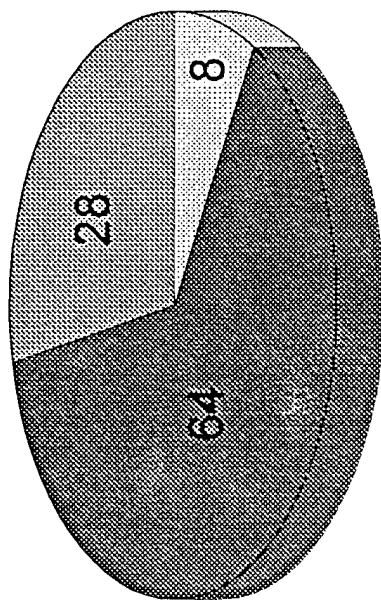
# Energy Consumption

*Fort Knox*

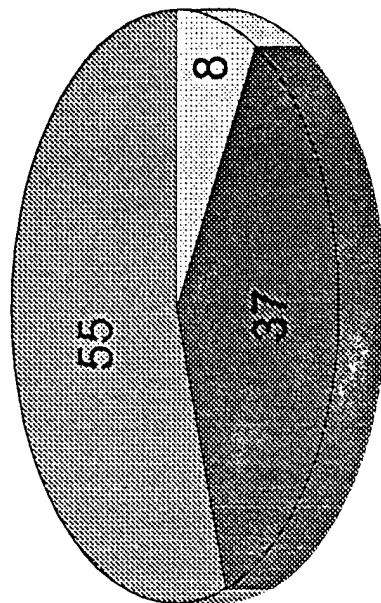


# Fort Knox Consumption vs Cost

FY 93



Total 2,329,574MBTU's



Total \$13,305,000

■ Electric

■ Natural Gas

■ Oil

# Cost and SIR by ECO

ECO	Cost	SIR
1	\$897,796	49.04
2	3,403	6190.68
2FH	2,668	4,251.42
3	139,965	3.27
3FH	3,043,912	2.34
4	103,381	2.54
6	198	4,704
7	21,832	4.82
8	28,556	51.67
10	247,186	6.18

## *APPENDIX D*

### *Rejected ECOs*



*ECO-9*

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECO9

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080

INSTALLATION & LOCATION: FT KNOX REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: ECO9 ENERGY EFFICIENT PUMP MOTORS

FISCAL YEAR 95 DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 11-16-94 ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	166498.		
B. SIOH	\$	61.		
C. DESIGN COST	\$	8325.		
D. TOTAL COST (1A+1B+1C)	\$	174884.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)			\$	174884.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH (1)	SAVINGS MWH/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	107.	\$ 1125.	20.96	\$ 23571.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 6423.	14.74	\$ 94675.
N. TOTAL		107.	\$ 7548.		\$ 118246.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ -99.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ -1459.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
1. REPLACEMENT	\$ 183148.	10	.74	135530.
d. TOTAL	\$ 183148.			135530.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 134070.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS\ ECONOMIC\ LIFE))$  \$ 16606.

5. SIMPLE PAYBACK PERIOD (1G/4) 10.53 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 252316.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 1.44  
(IF < 1 PROJECT DOES NOT QUALIFY)

\*\*\*\* Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

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=====
Estimate:      ECO - 9          Date:      15-Nov-94
Description:   INSTALL HIGH EFFICIENCY PUMP MOTORS
Project:       LIMITED EEAP (WTR) Bid Date:
Location:      FORT KNOX, KY    Job #:      94013.03
Sq. footage:   CNTRL WTR TMT PLANCity indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100280	MOTOR FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 230 VAC, 3 PH, 60 HP MTR					3.00 L.F.	
Unit values		0.50	8.12	9.53	0.00	0.00	17.64
Totals		1.50	\$24	\$29	\$0	\$0	\$53
0913100290	MOTOR FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 230 VAC, 3 PH, 75 HP MTR					3.00 L.F.	
Unit values		0.50	11.36	11.56	0.00	0.00	22.93
Totals		1.50	\$34	\$35	\$0	\$0	\$69
0913100320	MOTOR FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 230 VAC, 3PH, 125 HP MTR					6.00 L.F.	
Unit values		0.61	27.50	18.65	0.00	0.00	46.16
Totals		3.67	\$165	\$112	\$0	\$0	\$277
0913100330	MOTOR FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 230 VAC, 3 PH, 150 HP MTR					6.00 L.F.	
Unit values		0.61	27.03	21.49	0.00	0.00	48.51
Totals		3.67	\$162	\$129	\$0	\$0	\$291
0913100360	MOTOR FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 230VAC, 3PH, 200 HP MTR AND UP					15.00 L.F.	
Unit values		1.00	44.03	34.64	0.00	0.00	78.67
Totals		14.94	\$660	\$520	\$0	\$0	\$1,180
A09 ELECTRICAL		26	\$1,045	\$825	\$0	\$0	\$1,870

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=====
Line #      Description
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           Manhours  Matl    Labor  Equipment  Sub    Total
=====
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0207082740      ELEC DEMO, LABOR & EQUIP CHARG, PER MOTOR      11.00 Ea.

Unit values	4.00	0.00	113.08	0.00	0.00	113.08
Totals	44.00	\$0	\$1,244	\$0	\$0	\$1,244

U02 SITEWORK	44	\$0	\$1,244	\$0	\$0	\$1,244
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=====
Line #      Description
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            Manhours  Matl    Labor  Equipment  Sub      Total
=====
1635202000  INSTALL ENERGY EFFICIENT PUMP MOTOR 230/460V TOTENC
            60 HP, 1800 RPM                                1.00 Ea.
Unit values      5.71    4284.03    135.96      0.00      0.00    4420.00
Totals           5.71     $4,284      $136        $0        $0     $4,420

1635202050  INSTALL ENERGY EFFICIENT PUMP MOTOR 230/460V TOTENC
            75 HP 1800 RPM                                1.00 Ea.
Unit values      6.67    5519.90    158.48      0.00      0.00    5678.38
Totals           6.67     $5,520      $158        $0        $0     $5,678

1635202150  INSTALL ENERGY EFFICIENT PUMP MOTOR 230/460V TOTENC
            125 HP 1800 RPM                               2.00 Ea.
Unit values      11.43    9531.86    272.79      0.00      0.00    9804.65
Totals           22.86    $19,064      $546        $0        $0    $19,610

1635202200  INSTALL ENERGY EFFICIENT PUMP MOTOR 230/460V TOTENC
            150 HP 1800 RPM                               2.00 Ea.
Unit values      13.33    11125.75    316.09      0.00      0.00    11441.84
Totals           26.67     $22,252      $632        $0        $0    $22,884

1635202250  INSTALL ENERGY EFFICIENT PUMP MOTOR 230/460V TOTENC
            200 HP AND UP 1800 RPM                         5.00 Ea.
Unit values      16.00    13370.00    381.04      0.00      0.00    13751.04
Totals           80.00     $66,850      $1,905      $0        $0    $68,755

U16 ELECTRICAL      142    $117,970      $3,377        $0        $0    $121,347

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	212	\$119,015	\$5,446	\$0	\$0	\$124,461
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	22.00%		\$1,198			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	5.00%				\$0	
TOTAL BEFORE CONTINGENC		\$119,015	\$6,644	\$0	\$0	\$125,659
CONTINGENCY	20.00%					\$25,132
BOND	2.50%					\$3,141
PROFIT	10.00%					\$12,566
JOB TOTAL						\$166,498

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=====
Estimate:      ECO - 9          Date:      15-Nov-94
Description:   INSTALL HIGH EFFICIENCY PUMP MOTORS
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY    Job #:      94013.03
Sq. footage:  CNTRL WTR TMT PLAN City indx: Louisville, KY
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## SUMMARY

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Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      26    $1,045    $825        $0    $0    $1,870
U02 SITEWORK        44         $0    $1,244        $0    $0    $1,244
U16 ELECTRICAL     142   $117,970   $3,377        $0    $0   $121,347
TOTAL                212   $119,015   $5,446        $0    $0   $124,461

SALES TAX           0.00%         $0
MATL MARKUP         0.00%         $0
LABOR MARKUP        22.00%        $1,198
EQUIPT MARKUP        0.00%        $0
SUB MARKUP           5.00%        $0

TOTAL BEFORE CONTINGENC $119,015   $6,644        $0    $0   $125,659
CONTINGENCY          20.00%        $25,132
BOND                  2.50%        $3,141
PROFIT               10.00%        $12,566

JOB TOTAL                                $166,498

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31 October 1994

Central and Muldraugh Water Treatment Plants and Otter Creek

FACILITY NO.:

ECO Number 9  
 Energy Efficient Pump Motors

Baseline

Existing Pump Motors

Location	Pump	HP	Current Efficiency	Proposed Efficiency	Hours	Exist Energy (KWH)	Proposed Energy (KWH)	Energy Savings	Demand Savings (KW)	Energy Cost Savings	Demand Cost Savings	Total Savings
Muldraugh	A	350	91.5	95.4	500	142,677.6	136,844.9	5,832.7	70.0	\$146	\$980	\$1,126
Muldraugh	B	250	91.5	95.4	4000	815,300.5	781,970.6	33,329.9	50.0	\$835	\$700	\$1,535
Muldraugh	C	150	90	95.4	3000	373,000.0	351,886.8	21,113.2	42.2	\$529	\$591	\$1,120
Muldraugh	Back	125	90	95.4	200	20,722.2	19,549.3	1,173.0	35.2	\$29	\$493	\$522
Central	1	250	91	95.4	2000	409,890.1	390,985.3	18,904.8	56.7	\$474	\$794	\$1,268
Central	2	60	90	95	2000	99,466.7	94,231.6	5,235.1	15.7	\$131	\$220	\$351
Central	3	75	90	95.4	2000	124,333.3	117,295.6	7,037.7	21.1	\$176	\$296	\$472
Central	Back	125	90.2	95.4	200	20,676.3	19,549.3	1,127.0	33.8	\$28	\$473	\$502
Otter Creek	4	150	91	95.4	2000	245,934.1	234,591.2	11,342.9	34.0	\$284	\$476	\$761
Otter Creek	9	250	91.5	95.4	2000	407,650.3	390,985.3	16,664.9	50.0	\$417	\$700	\$1,117
Otter Creek	10	250	91.5	95.4	2000	407,650.3	390,985.3	16,664.9	50.0	\$417	\$700	\$1,117
Total						3,067,301.4	2,928,875.2	138,426.2	458.8	\$3,468	\$6,423	\$9,890

Energy Savings 138,4262  
 Energy Cost Savings \$3,468  
 Demand Cost Savings \$6,423  
 Total Cost Savings \$9,890



*ECO-11*

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 1467SEN1  
 INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: ECO11 MISC. SINKS      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: WATER  
 ANALYSIS DATE: 11-09-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	17336.	
B. SIOH	\$	867.	
C. DESIGN COST	\$	867.	
D. TOTAL COST (1A+1B+1C)	\$	19070.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		19070.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	1436.	\$ 15092.	20.96	\$ 316336.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1436.	\$ 15092.		\$ 316336.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 2607.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 38427.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) COST(-) (4)
1. REPLACEMENT	\$ 19070.	10	.74	14112.
d. TOTAL	\$ 19070.			14112.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 52539.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) \$ 18653.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.02 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 368875.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 19.34  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 19.56 %

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 1467SEN3

LCCID 1.080

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: ECO11 WATER CLOSETS

FISCAL YEAR 95      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 11-09-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	15945.		
B. SIOH	\$	797.		
C. DESIGN COST	\$	797.		
D. TOTAL COST (1A+1B+1C)	\$	17539.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				\$ 17539.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH (1)	SAVINGS MWH/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	0.	\$ 0.	20.96	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		0.	\$ 0.		\$ 0.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)		\$ 691.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 10185.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-)	YR OC	DISCNT FACTR	DISCOUNTED SAVINGS (+) / COST (-) (4)
	(1)	(2)	(3)	
1. REPLACEMENT	\$ 17540.	10	.74	12980.
d. TOTAL	\$ 17540.			12980.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 23165.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS\ ECONOMIC\ LIFE))$  \$ 1568.

5. SIMPLE PAYBACK PERIOD (1G/4) 11.19 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 23165.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 1.32  
(IF < 1 PROJECT DOES NOT QUALIFY)

\*\*\*\* Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 1467SEN4

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LCCID 1.080

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: ECO 11 URINALS

FISCAL YEAR 95      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 11-09-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	1334.	
B. SIOH	\$	67.	
C. DESIGN COST	\$	67.	
D. TOTAL COST (1A+1B+1C)	\$	1468.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$	1468.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	0.	\$ 0.	20.96	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		0.	\$ 0.		\$ 0.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 39.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 575.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
1. REPLACEMENT	\$ 1467.	10	.74	1086.
d. TOTAL	\$ 1467.			1086.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 1660.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS\ ECONOMIC\ LIFE))$  \$ 112.

5. SIMPLE PAYBACK PERIOD (1G/4) 13.07 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1660.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 1.13  
(IF < 1 PROJECT DOES NOT QUALIFY)

\*\*\*\* Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 1468SEN1  
 INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: ECO 11 MISC. SINKS      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: WATER  
 ANALYSIS DATE: 11-09-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	11053.		
B. SIOH	\$	553.		
C. DESIGN COST	\$	553.		
D. TOTAL COST (1A+1B+1C)	\$	12159.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)			\$	12159.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH (1)	SAVINGS MWH/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	957.	\$ 10058.	20.96	\$ 210817.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		957.	\$ 10058.		\$ 210817.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 1738.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 25618.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
1. REPLACEMENT	\$ 12158.	10	.74	8997.
d. TOTAL	\$ 12158.			8997.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 34615.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 12404.

5. SIMPLE PAYBACK PERIOD (1G/4) .98 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 245432.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 20.19  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 19.81 %

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 1468SEN3

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID 1.080

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: ECO 11 WATER CLOSETS

FISCAL YEAR 95      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 11-09-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	6602.		
B. SIOH	\$	330.		
C. DESIGN COST	\$	330.		
D. TOTAL COST (1A+1B+1C)	\$	7262.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		7262.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH (1)	SAVINGS MWH/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	0.	\$ 0.	20.96	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		0.	\$ 0.		\$ 0.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 202.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 2977.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-)	YR OC	DISCNT FACTR	DISCOUNTED SAVINGS (+) / COST (-) (4)
	(1)	(2)	(3)	
1. REPLACEMENT	\$ 7262.	10	.74	5374.
d. TOTAL	\$ 7262.			5374.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 8351.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) \$ 565.

5. SIMPLE PAYBACK PERIOD (1G/4) 12.85 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 8351.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 1.15  
(IF < 1 PROJECT DOES NOT QUALIFY)

\*\*\*\* Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 1468SEN4  
 INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: ECO 11 URINALS      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: WATER  
 ANALYSIS DATE: 11-09-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	3756.	
B. SIOH	\$	188.	
C. DESIGN COST	\$	188.	
D. TOTAL COST (1A+1B+1C)	\$	4132.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		4132.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH (1)	SAVINGS MWH/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	0.	\$ 0.	20.96	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		0.	\$ 0.		\$ 0.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)		
(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 141.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 2078.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
1. REPLACEMENT	\$ 4132.	10	.74	3058.
d. TOTAL	\$ 4132.			3058.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 5136.

4. FIRST YEAR DOLLAR SAVINGS: 2N3+3A+ (3Bd1 / (YRS ECONOMIC LIFE)) \$ 348.

5. SIMPLE PAYBACK PERIOD (1G/4) 11.89 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 5136.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 1.24  
 (IF < 1 PROJECT DOES NOT QUALIFY)

\*\*\*\* Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

=====

Estimate:	ECO - 11	Date:	09-Nov-94
Description:	UPGRADE FAUCETS, WATER CLOSETS, & URINALS W/ AUTO SENSORS		
Project:	LIMITED EEAP (WTR)	Bid Date:	
Location:	FORT KNOX, KY	Job #:	94013.03
Sq. footage:	BLDG 1467	City indx:	Louisville, KY

=====

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	RECEPTACLE FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 60 AMPERES					300.00 L.F.	
Unit values		0.15	2.62	5.02	0.00	0.00	7.64
Totals		44.70	\$785	\$1,507	\$0	\$0	\$2,292
A09 ELECTRICAL		45	\$785	\$1,507	\$0	\$0	\$2,292



```

=====
Line #      Description
-----
Manhours   Matl      Labor    Equipment   Sub      Total
=====

1511410972  INSTALL AUTO FLUSH SENSOR AND OPERATOR FOR WATER
CLOSETS    INCLUDING REMOVAL OF EXISTING      38.00 Ea.
Unit values 1.50      256.00      40.63      0.00      0.00      296.63
Totals      57.00      $9,728      $1,544      $0         $0      $11,272

1511410972  INSTALL AUTO FLUSH SENSOR AND OPERATOR FOR URINAL
INCLUDING REMOVAL OF EXISTING      2.00 Ea.
Unit values 1.64      256.00      48.05      0.00      0.00      304.05
Totals      3.28      $512        $96        $0         $0      $608

1511412810  INSTALL LAV FAUCET W/ AUTO SENSOR AND OPERATOR
INCLUDING REMOVAL OF EXISTING      24.00 Ea.
Unit values 2.30      262.00      58.94      0.00      0.00      320.94
Totals      55.20      $6,288      $1,415      $0         $0      $7,703

1554717520  SOLENOID VALVE FOR FAUCET W/ AUTO SENSOR,
3/4" NTP 24 VOLTS      24.00 Ea.
Unit values 0.89      156.00      20.03      0.00      0.00      176.03
Totals      21.34      $3,744      $481        $0         $0      $4,225

U15 MECHANICAL 137      $20,272      $3,536      $0         $0      $23,808

```

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1621100200	RECEPTACLE OUTLET BOX STEEL 4" SQUARE EXT					
					20.00 Ea.	
Unit values	0.20	1.86	4.76	0.00	0.00	6.63
Totals	4.00	\$37	\$95	\$0	\$0	\$132
1623104200	LO VOLT TRANSFORMER 115V TO 25V					
					20.00 Ea.	
Unit values	0.67	76.40	15.89	0.00	0.00	92.29
Totals	13.34	\$1,528	\$318	\$0	\$0	\$1,846
1623202480	GROUND FAULT INDICATING RECEPTACLE, 15 AMP					
					20.00 Ea.	
Unit values	0.30	26.74	7.06	0.00	0.00	33.80
Totals	5.92	\$535	\$141	\$0	\$0	\$676
1623204920	RECEPTACLE COVER PL. STAINLESS STL NEMA 5&6					
					20.00 Ea.	
Unit values	0.10	2.20	2.38	0.00	0.00	4.58
Totals	2.00	\$44	\$48	\$0	\$0	\$92
U16 ELECTRICAL	26	\$2,144	\$602	\$0	\$0	\$2,746

```
=====
Line #      Description
-----
            Manhours   Matl     Labor   Equipment   Sub     Total
=====
ESTIMATE TOTAL      208    $23,201    $5,645           $0         $0    $28,846

SALES TAX           0.00%           $0
MATL MARKUP         0.00%           $0
LABOR MARKUP        0.00%           $0
EQUIPT MARKUP       0.00%           $0
SUB MARKUP          0.00%           $0

TOTAL BEFORE CONTINGENC $23,201    $5,645           $0         $0    $28,846
CONTINGENCY          10.00%           $2,885
BOND                 0.00%           $0
PROFIT              10.00%           $2,885

JOB TOTAL                                     $34,615
=====
```

```

=====
Estimate:      ECO - 11          Date:      09-Nov-94
Description:   UPGRADE FAUCETS, WATER CLOSETS, & URINALS W/ AUTO SENSORS
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY      Job #:      94013.03
Sq. footage:  BLDG 1467         City indx: Louisville, KY
=====

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## SUMMARY

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              Manhours   Matl      Labor   Equipment   Sub      Total
=====
A09 ELECTRICAL      45        $785    $1,507         $0        $0    $2,292
U15 MECHANICAL     137    $20,272    $3,536         $0        $0    $23,808
U16 ELECTRICAL      26     $2,144     $602         $0        $0    $2,746
TOTAL                208    $23,201    $5,645         $0        $0    $28,846

SALES TAX           0.00%         $0
MATL MARKUP         0.00%         $0
LABOR MARKUP        0.00%         $0
EQUIPT MARKUP       0.00%         $0
SUB MARKUP          0.00%         $0

TOTAL BEFORE CONTINGENC $23,201    $5,645         $0        $0    $28,846
CONTINGENCY          10.00%         $2,885
BOND                 0.00%         $0
PROFIT               10.00%         $2,885

JOB TOTAL                                     $34,615

```

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=====
Estimate:      ECO - 11          Date:      09-Nov-94
Description:   UPGRADE FAUCETS, WATER CLOSETS, & URINALS W/ AUTO SENSORS
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY      Job #:      94013.03
Sq. footage:  BLDG 1468         City indx: Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	RECEPTACLE FEEDER INSTALLATION, INCLUDING CONDUIT AND WIRE, 60 AMPERES					150.00 L.F.	
Unit values		0.15	2.62	5.02	0.00	0.00	7.64
Totals		22.35	\$393	\$753	\$0	\$0	\$1,146
A09 ELECTRICAL		23	\$393	\$753	\$0	\$0	\$1,146

=====						
Line #	Description					
-----						
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1511410972	INSTALL AUTO FLUSH SENSOR AND OPERATOR FOR WATER CLOSETS INCLUDING REMOVAL OF EXISTING					16.00 Ea.
Unit values	1.50	256.00	40.63	0.00	0.00	296.63
Totals	24.00	\$4,096	\$650	\$0	\$0	\$4,746
1511410972	INSTALL AUTO FLUSH SENSOR AND OPERATOR FOR URINAL INCLUDING REMOVAL OF EXISTING					9.00 Ea.
Unit values	1.64	256.00	48.05	0.00	0.00	304.05
Totals	14.76	\$2,304	\$432	\$0	\$0	\$2,736
1511412810	INSTALL LAV FAUCET W/ AUTO SENSOR AND OPERATOR INCLUDING REMOVAL OF EXISTING					16.00 Ea.
Unit values	2.30	262.00	58.94	0.00	0.00	320.94
Totals	36.80	\$4,192	\$943	\$0	\$0	\$5,135
1554717520	SOLENOID VALVE FOR FAUCET W/ AUTO SENSOR, 3/4" NTP 24 VOLTS					16.00 Ea.
Unit values	0.89	156.00	20.03	0.00	0.00	176.03
Totals	14.22	\$2,496	\$320	\$0	\$0	\$2,816
U15 MECHANICAL	90	\$13,088	\$2,345	\$0	\$0	\$15,433

```

=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub      Total
=====

1621100200  RECEPTACLE OUTLET BOX STEEL 4" SQUARE EXT
Unit values      0.20      1.86      4.76      0.00      10.00 Ea.      6.63
Totals           2.00      $19      $48      $0      $0      $67

1623104200  LO VOLT TRANSFORMER 115V TO 25V
Unit values      0.67      76.40     15.89      0.00      10.00 Ea.     92.29
Totals           6.67      $764     $159      $0      $0      $923

1623202480  GROUND FAULT INDICATING RECEPTACLE, 15 AMP
Unit values      0.30      26.74      7.06      0.00      10.00 Ea.     33.80
Totals           2.96      $267      $71      $0      $0      $338

1623204920  RECEPTACLE COVER PL. STAINLESS STL NEMA 5&6
Unit values      0.10      2.20      2.38      0.00      10.00 Ea.      4.58
Totals           1.00      $22      $24      $0      $0      $46

U16 ELECTRICAL      13      $1,072      $302      $0      $0      $1,374

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
ESTIMATE TOTAL      126    $14,553    $3,400          $0        $0    $17,953
SALES TAX           0.00%          $0
MATL MARKUP         0.00%          $0
LABOR MARKUP        0.00%          $0
EQUIPT MARKUP       0.00%          $0
SUB MARKUP          0.00%          $0
TOTAL BEFORE CONTINGENC $14,553    $3,400          $0        $0    $17,953
CONTINGENCY         10.00%          $1,795
BOND                0.00%          $0
PROFIT              10.00%          $1,795
JOB TOTAL                                $21,544
=====
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=====
Estimate:      ECO - 11          Date:      09-Nov-94
Description:    UPGRADE FAUCETS, WATER CLOSETS, & URINALS W/ AUTO SENSORS
Project:        LIMITED EEAP (WTR) Bid Date:
Location:       FORT KNOX, KY    Job #:      94013.03
Sq. footage:    BLDG 1468        City indx: Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      23      $393      $753          $0      $0      $1,146
U15 MECHANICAL      90     $13,088     $2,345          $0      $0     $15,433
U16 ELECTRICAL      13      $1,072      $302          $0      $0      $1,374
TOTAL                126     $14,553     $3,400          $0      $0     $17,953

SALES TAX           0.00%          $0
MATL MARKUP         0.00%          $0
LABOR MARKUP        0.00%          $0
EQUIPT MARKUP       0.00%          $0
SUB MARKUP          0.00%          $0

TOTAL BEFORE CONTINGENC $14,553     $3,400          $0      $0     $17,953
CONTINGENCY         10.00%          $0
BOND                 0.00%          $0
PROFIT              10.00%          $0
JOB TOTAL                                $21,544

```

# FY94S EEAP FT. KNOX WATER CONSERVATION STUDY

## CALCULATION WORK SHEET 1

DATE: 31 Oct 94

FACILITY NO.: 1467 FUNCTION: Enlisted Barracks

Occupancy: 200 Operating Hours: 15

ECO Type	Existing Fixture System		Retrofited Fixture System		Usage HRS/YR	Fixtures Quantity	Water Leaks Eliminated LPY
	Description	LPM	Description	LPM			
Lavatory Sinks	Public Lavatory	9.5	Spring Loaded Faucets	4.7	730	24	
TOTAL:							
Misc. Sinks	Laundry Sink	23	Install Aerators	9.5	2080	8	0
TOTAL:							
Water Closets	Floor Mounted Flush Valve	17	Install 3.5 GPF Flush Valve	13.2	11526	38	0
			Repair Kit				
TOTAL:							
Urinals	Wall Mounted Flush Valve	5.68	Install 1.0 GPF Flush Valve	3.79	25000	2	0
			Repair Kit				
TOTAL:							
Shower Heads							
TOTAL:							
Equipment Related							
TOTAL:							
TOTAL:							

CALCULATION WORK SHEET 2

FACILITY NO.: 1467 Water Rate: 0.42 \$/KL Energy Rate: \$/KWH

Gas Rate: 10.51 \$/MWH Demand Rate: \$/KW

ECO Type	Annual Water		Annual Energy Saving			WATER		Total	
	Saving	LPY	ELEC KW	ELEC KWH	GAS MWH	Dollar Saving	Dollar Saving	Dollar Saving	Dollars Invested
Lavatory Sinks	6,280,920				1436	\$2,606.58	\$17,695.78	\$5,875.20	
	0				0	\$0.00	\$0.00	\$0.00	
TOTAL:	6,280,920		0	0	1,436	\$2,606.58	\$17,695.78	\$5,875.20	
Misc. Sinks	13,478,400				3081	\$5,593.54	\$37,973.87	\$77.57	
TOTAL:	13,478,400		0	0	3,081	\$5,593.54	\$37,973.87	\$77.57	
Water Closets	1,664,354					\$690.71	\$690.71	\$2,281.82	
TOTAL:	1,664,354					\$690.71	\$690.71	\$2,281.82	
Urinals	94,500					\$39.22	\$39.22	\$127.30	
TOTAL:	94,500					\$39.22	\$39.22	\$127.30	
Shower Heads	0				0	\$0.00	\$0.00	\$0.00	
TOTAL:	0		0	0	0	\$0.00	\$0.00	\$0.00	
Equipment Related									
TOTAL:	0		0	0	0	\$0.00	\$0.00	\$0.00	

SYSTEMS CORP

Systems Engineering and Management Corporation, Knoxville, TN

# FY94S EEAP FT. KNOX WATER CONSERVATION STUDY

1002

## CALCULATION WORK SHEET 1

DATE: 31 Oct 94

FACILITY NO.: 1468

FUNCTION: Enlisted Barracks

Occupancy: 120 Operating Hours: 24

ECO Type	Existing Fixture System		Retrofited Fixture System		Usage HRS/YR	Fixtures Quantity	Water Leaks Eliminated LPY
	Description	LPM	Description	LPM			
Lavatory Sinks	Public Lavatory	9.5	Spring Loaded Faucets	4.7	730	16	
TOTAL:							
Misc. Sinks	Laundry Sink	32	Install Aerators	9.5	2080	8	0
TOTAL:							
Water Closets	Floor Mounted Flush Valve	17	Install 3.5 GPF Flush Valve	13.2	8000	16	
			Repair Kit				
TOTAL:							
Urinals	Wall Mounted Flush Valve	5.68	Install 1.0 GPF Flush Valve	3.79	20000	9	0
			Repair Kit				
TOTAL:							
Shower Heads							
TOTAL:							
Equipment Related							
TOTAL:							
TOTAL:						0	0

**SYSTEMS CORP**

Systems Engineering and Management Corporation, Knoxville, TN

# FY94S EEAP FT. KNOX WATER CONSERVATION STUDY

2 OF 2

## CALCULATION WORK SHEET 2

FACILITY NO.: 1468  
 Water Rate: 0.42 \$/KL Energy Rate: \$/KWH  
 Gas Rate: 10.51 \$/MWH Demand Rate: \$/KW

ECO Type	Annual Water Saving LPY	Annual Energy Saving			WATER	Total Dollar Saving	Total Dollar Saving	Total Dollars Invested
		ELEC KW	ELEC KWH	GAS MWH				
Lavatory Sinks	4,187,280			957	\$1,737.72	\$11,797.19	\$3,916.80	
	0			0	\$0.00	\$0.00	\$0.00	
TOTAL:	4,187,280	0	0	957	\$1,737.72	\$11,797.19	\$3,916.80	
Misc. Sinks	22,464,000			5135	\$9,322.56	\$63,289.78	\$77.57	
TOTAL:	22,464,000	0	0	5,135	\$9,322.56	\$63,289.78	\$77.57	
Water Closets	486,400				\$201.86	\$201.86	\$960.77	
TOTAL:	486,400				\$201.86	\$201.86	\$960.77	
Urinals	340,200				\$141.18	\$141.18	\$572.83	
TOTAL:	340,200				\$141.18	\$141.18	\$572.83	
Shower Heads	0			0	\$0.00	\$0.00	\$0.00	
TOTAL:	0	0	0	0	\$0.00	\$0.00	\$0.00	
Equipment Related								
TOTAL:	0	0	0	0	\$0.00	\$0.00	\$0.00	

**SYSTEMS CORP**

Systems Engineering and Management Corporation, Knoxville, TN

*ECO-12*

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 0419ECO6  
LCCID 1.080

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: ECO 12 HOT WATER HEATERS

FISCAL YEAR 95      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 11-16-94      ECONOMIC LIFE 20 YEARS      PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	60.		
B. SIOH	\$	3.		
C. DESIGN COST	\$	3.		
D. TOTAL COST (1A+1B+1C)	\$	66.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			66.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	0.	\$ 1.	20.96	\$ 15.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		0.	\$ 1.		\$ 15.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	14.74		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) / COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) / COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3Bd4) \$ 0.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 1.

5. SIMPLE PAYBACK PERIOD (1G/4) 89.71 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 15.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = .23  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -4.13 %

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 0450ECO6

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID 1.080

INSTALLATION & LOCATION: FT KNOX      REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: ECO 12 HOT WATER HEATERS

FISCAL YEAR 95      DISCRETE PORTION NAME: WATER

ANALYSIS DATE: 11-16-94      ECONOMIC LIFE 20 YEARS PREPARED BY: DERRINGTON

1. INVESTMENT

A. CONSTRUCTION COST	\$	60.	
B. SIOH	\$	3.	
C. DESIGN COST	\$	3.	
D. TOTAL COST (1A+1B+1C)	\$	66.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$	66.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/ MWH(1)	SAVINGS MWH/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ .00	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 10.51	0.	\$ 1.	20.96	\$ 15.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		0.	\$ 1.		\$ 15.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$	0.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 0.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 1.

5. SIMPLE PAYBACK PERIOD (1G/4) 89.71 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 15.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = .23  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -4.13 %



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Estimate:      ECO - 12          Date:      05-Oct-94
Description:    REDUCE HOT WATER TEMP & INSTALL WTR HTR WRAP - FAMILY HOUS
Project:       LIMITED EEAP (WTR) Bid Date:
Location:      FORT KNOX, KY     Job #:      94013.03
Sq. footage:   BLDG 419 A       City indx: Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
1556512920	INSTALL WTR HTR WRAP, 1-1/2 " FGLS					1.00 Ea.	
Unit values		1.00	27.00	22.83	0.00	0.00	49.83
Totals		1.00	\$27	\$23	\$0	\$0	\$50
1556512925	REDUCE WATER HEATER SETTING					1.00 Ea.	
Unit values		0.50	0.00	14.15	0.00	0.00	14.15
Totals		0.50	\$0	\$14	\$0	\$0	\$14
U15 MECHANICAL		2	\$27	\$37	\$0	\$0	\$64

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====

ESTIMATE TOTAL      2      $27      $37      $0      $0      $64

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC      $27      $37      $0      $0      $64
CONTINGENCY          10.00%
BOND                 0.00%
PROFIT               10.00%

JOB TOTAL                                           $77
```

```

=====
Estimate:      ECO - 12          Date:      05-Oct-94
Description:   REDUCE HOT WATER TEMP & INSTALL WTR HTR WRAP - FAMILY HOUS
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY      Job #:      94013.03
Sq. footage:  BLDG  419 A        City indx: Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U15 MECHANICAL      2      $27      $37      $0      $0      $64
TOTAL                2      $27      $37      $0      $0      $64
SALES TAX            0.00%      $0
MATL MARKUP          0.00%      $0
LABOR MARKUP         0.00%      $0
EQUIPT MARKUP        0.00%      $0
SUB MARKUP           0.00%      $0
TOTAL BEFORE CONTINGENC      $27      $37      $0      $0      $64
CONTINGENCY          10.00%      $6
BOND                  0.00%      $0
PROFIT               10.00%      $6
JOB TOTAL                                $77

```

```

=====
Estimate:      ECO - 12          Date:      05-Oct-94
Description:    REDUCE WATER HEATER TEMP & INSTALL WTR HTR WRAP - FAMILY H
Project:        LIMITED EEAP (WTR) Bid Date:
Location:       FORT KNOX, KY    Job #:      94013.03
Sq. footage:    BLDG 450 A&B     City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
1556512920	ECO - 6 INSTALL WTR HTR WRAP, 1-1/2 " FGLS					1.00 Ea.	
Unit values		1.00	27.00	22.83	0.00	0.00	49.83
Totals		1.00	\$27	\$23	\$0	\$0	\$50
1556512925	ECO - 6 REDUCE WATER HEATER SETTING					1.00 Ea.	
Unit values		0.50	0.00	14.15	0.00	0.00	14.15
Totals		0.50	\$0	\$14	\$0	\$0	\$14
U15 MECHANICAL		2	\$27	\$37	\$0	\$0	\$64

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	2	\$27	\$37	\$0	\$0	\$64
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$27	\$37	\$0	\$0	\$64
CONTINGENCY	10.00%					\$6
BOND	0.00%					\$0
PROFIT	10.00%					\$6
JOB TOTAL						\$77

```

=====
Estimate:      ECO - 12          Date:      05-Oct-94
Description:   REDUCE WATER HEATER TEMP & INSTALL WTR HTR WRAP - FAMILY H
Project:      LIMITED EEAP (WTR) Bid Date:
Location:     FORT KNOX, KY      Job #:      94013.03
Sq. footage:  BLDG  450 A&B      City indx: Louisville, KY
=====

```

## SUMMARY

```

-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
U15 MECHANICAL      2          $27      $37         $0          $0        $64
TOTAL                2          $27      $37         $0          $0        $64
SALES TAX            0.00%        $0
MATL MARKUP          0.00%        $0
LABOR MARKUP         0.00%        $0
EQUIPT MARKUP        0.00%        $0
SUB MARKUP           0.00%        $0
TOTAL BEFORE CONTINGENC $27      $37         $0          $0        $64
CONTINGENCY          10.00%        $6
BOND                 0.00%        $0
PROFIT               10.00%        $6
JOB TOTAL                                $77

```

10

# CALCULATION WORK SHEET 1

DATE: 5 OCT 94

UNACCOM PERS HOUS DET FAC  
TYPICAL OF 21 UNITS

**FUNCTION:**

**419 A**

## Operating Hours:

## FAMILY

ECO Type	Existing Fixture System		Retrofited Fixture System		Usage HRS/YR	Fixtures Quantity	Water Leaks Eliminated LPY
	Description	LPM	Description	LPM			
Lavatory Sinks	SINK W/ AERATOR	9.5	NO RETROFIT	9.5	125	2	
TOTAL:							
Misc. Sinks	KITCHEN SINK	LPM	NO RETROFIT	LPM	365	2	0
	SERVICE SINK	22.7	INSTALL AERATOR	9.5	60	1	0
TOTAL:							
Water Closets	TANK TYPE	LPF	1.6 GPF TANK TYPE TOILET	LPF	#FL/YR	2	0
		19		6.1	14600	1	
TOTAL :							
Urinals		LPF		LPF	#FL/YR	1	0
TOTAL :							
Shower Heads	RESIDENTIAL TYPE	LPM	NO RETROFIT	LPM	HRS/YR	0	0
		9.5		9.5	245	1	0
TOTAL :							
	40 GAL REPUBLIC #406	TEMP		TEMP		1	0
Water Heater (GAS)	CAPACITY: 38,000 BTU/H	325	REDUCE STORAGE TEMP	322	8760	1	
	RECOVERY: 32 GAL/HR		INSTALL INSUL JACKET	322	8760	1	
TOTAL :							
TOTAL :							

# SYSTEMS CORP

**Systems Engineering and Management Corporation, Knoxville, TN**

# FY94S EEAP FT. KNOX WATER CONSERVATION STUDY

2 OF 2

## CALCULATION WORK SHEET 2

FACILITY NO.: 419 A Water Rate: 0.42 \$/KL Energy Rate: \$/KWH

Gas Rate: 10.51 \$/MWH Demand Rate: \$/KW

ECO Number	ECO Type	Annual Water		Annual Energy Saving			WATER		Total	Total	Dollars Invested
		Saving	LPY	ELEC KW	ELEC KWH	GAS MWH	Dollar Saving	Dollar Saving			
	Lavatory Sinks	0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	TOTAL:	0		0	0	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Misc. Sinks	47,520				11	\$19.72	\$133.88	\$133.88	\$9.70	\$9.70
		0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	TOTAL:	47,520		0	0	11	\$19.72	\$133.88	\$133.88	\$9.70	\$9.70
		188,340					\$78.16	\$78.16	\$78.16	\$418.80	\$418.80
	Water Closets	0					\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		0					\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	TOTAL:	188,340					\$78.16	\$78.16	\$78.16	\$418.80	\$418.80
		0					\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Urinals	0					\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		0					\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	TOTAL:	0					\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Shower Heads	0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		0				0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	TOTAL:	0		0	0	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	EST ANNUAL										
	Water	HOT WTR				0.23		\$2.42	\$2.42	\$16.80	\$16.80
	Heater	CONSUMPTION				0.07		\$0.71	\$0.71	\$60.00	\$60.00
	(GAS)	(LITERS)									
		43,946									
	TOTAL:	43,946		0	0	0	\$0.00	\$3.13	\$3.13	\$76.80	\$76.80

**SYSTEMS CORP**

Systems Engineering and Management Corporation, Knoxville, TN



# FY94S EEAP FT. KNOX WATER CONSERVATION STUDY

101

## CALCULATION WORK SHEET 1

DATE: 5 OCT 94

FACILITY NO.: 450 A&B

FUNCTION:

UNACCOM PERS HOUS DET FAC  
TYPICAL OF 58 UNITS

FAMILY

Operating Hours:

24

Occupancy:

ECO Number ECO Type	Existing Fixture System		Retrofited Fixture System		Usage HRS/YR	Fixtures Quantity	Water Leaks Eliminated LPY
	Description	LPM	Description	LPM			
Lavatory Sinks	SINK W/ AERATOR	9.5	NO RETROFIT	9.5	125	2	
TOTAL:		LPM		LPM		2	0
Misc. Sinks	KITCHEN SINK	9.5	NO RETROFIT	9.5	365	1	0
	SERVICE SINK	22.7	INSTALL AERATOR	9.5	60	1	
TOTAL:		LPM		LPM	#FL/YR	2	0
Water Closets	TANK TYPE	19	1.6 GPF TANK TYPE TOILET	6.1	14600	1	
TOTAL:		LPM		LPM	#FL/YR	1	0
Urinals							
TOTAL:		LPM		LPM	HRS/YR	0	0
Shower Heads	RESIDENTIAL TYPE	9.5	NO RETROFIT	9.5	245	1	0
TOTAL:		TEMP		TEMP		1	0
Water	40 GAL REPUBLIC #406						
Heater	CAPACITY: 38,000 BTU/H	325	REDUCE STORAGE TEMP	322	8760	1	
(GAS)	RECOVERY: 32 GAL/HR		INSTALL INSUL JACKET	322	8760	1	
TOTAL:						1	0

**SYSTEMS CORP**

Systems Engineering and Management Corporation, Knoxville, TN

*ECO-16*

# FY94S EEAP FT. KNOX WATER CONSERVATION STUDY

2 OF 2

## CALCULATION WORK SHEET 2

FACILITY NO.: 450 A&B Water Rate: 0.42 \$/KL Energy Rate: \$/KWH

Gas Rate: 10.51 \$/MWH Demand Rate: \$/KW

ECO Number	Annual Water Saving LPY	Annual Energy Saving			WATER Dollar Saving	Total Dollar Saving	Total Dollars Invested
		ELEC KW	ELEC KWH	GAS MWH			
Lavatory Sinks	0			0	\$0.00	\$0.00	\$0.00
	0			0	\$0.00	\$0.00	\$0.00
	0			0	\$0.00	\$0.00	\$0.00
TOTAL:	0	0	0	0	\$0.00	\$0.00	\$0.00
	0			0	\$0.00	\$0.00	\$0.00
Misc. Sinks	47,520			82	\$19.72	\$883.25	\$9.70
	0			0	\$0.00	\$0.00	\$0.00
TOTAL:	47,520	0	0	82	\$19.72	\$883.25	\$9.70
	188,340				\$78.16	\$78.16	\$418.80
Water Closets	0				\$0.00	\$0.00	\$0.00
	0				\$0.00	\$0.00	\$0.00
TOTAL:	188,340				\$78.16	\$78.16	\$418.80
	0				\$0.00	\$0.00	\$0.00
Urinals	0				\$0.00	\$0.00	\$0.00
	0				\$0.00	\$0.00	\$0.00
TOTAL:	0				\$0.00	\$0.00	\$0.00
	0			0	\$0.00	\$0.00	\$0.00
Shower Heads	0			0	\$0.00	\$0.00	\$0.00
	0			0	\$0.00	\$0.00	\$0.00
TOTAL:	0	0	0	0	\$0.00	\$0.00	\$0.00
EST ANNUAL							
Water	HOT WTR			0.23		\$2.42	\$16.80
Heater (GAS)	CONSUMPTION (LITERS)			7.70		\$80.96	\$60.00
	43,946						
TOTAL:	43,946	0	0	8	\$0.00	\$83.38	\$76.80

**SYSTEMS CORP**

Systems Engineering and Management Corporation, Knoxville, TN

FY94S EEA, KNOX WATER CONSERVATION STUDY  
 CALCULATION WORK SHEET DATE 1 December 1994  
 FACILITY NO.: Hospital Cooling Tower Water Treatment

ECO Number 16 Ozone Water Treatment

Baseline

Betz Entec Chemicals 365, 368 and 402 are used to treat cooling tower water, conductivity controlled blowdown.

Quantity	Cooling Towers	Flowrate (LPM)	Evaporation Rate (LPM)	Cycles of Concentration	Blowdown (LPM)	Annual Blowdown (4380 hours)
4	400 ton	4542	58.30	3.00	29.15	30,642,480 liters
3	300 ton	3407	43.50	3.00	21.75	17,147,700 liters
						47,790,180 liters
						\$0.000249 per liter

Proposed Retrofit

Install ozone water treatment system and eliminate chemical treatment and increase cycles of concentration

Quantity	Cooling Towers	Flowrate (LPM)	Evaporation Rate (LPM)	Cycles of Concentration	Blowdown (LPM)	Annual Blowdown (4380 hours)
4	400 ton	4542	58.30	6.00	11.66	12,256,992 liters
3	300 ton	3407	43.50	6.00	8.7	6,859,080 liters
						19,116,072 liters
						\$0.000249 per liter
						\$4,760

Savings Summary

Annual Water Savings of	28,674,108 liters
Annual Water Cost Savings of	\$7,140
Annual Chemical Cost Savings	\$1,953
Total Annual Cost Savings	\$9,093